WORKS NUMBER.

THE ENGLISH ELECTRIC JOURNAL

ORDNANCE WORKS, COVENTRY.
DICK, KERR WORKS, PRESTON.
PHOENIX WORKS, BRADFORD.
SIEMENS WORKS, STAFFORD.
WILLANS WORKS, RUGBY.

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The English Electric Company Limited.

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SIEMENS BROS. & CO., LIMITED
ENGLISH ELECTRIC & SIEMENS SUPPLIES LIMITED
CONSOLIDATED CONSTRUCTION COMPANY LIMITED
CONSTRUCTIONS ELECTRIQUES DE FRANCE
CONSTRUCTIONS ELECTRIQUES DE BELGIQUE
ENGLISH ELECTRIC COMPANY OF AUSTRALIA, LIMITED
TOYO DENKI SEIZO KABUSHIKI KAISHA

Works:

ORDNANCE WORKS, Coventry
DICK, KERR WORKS, Preston
PHOENIX WORKS, Bradford
SIEMENS WORKS, Stafford
WILLANS WORKS, Rugby

The ENGLISH ELECTRIC JOURNAL

WORKS NUMBER

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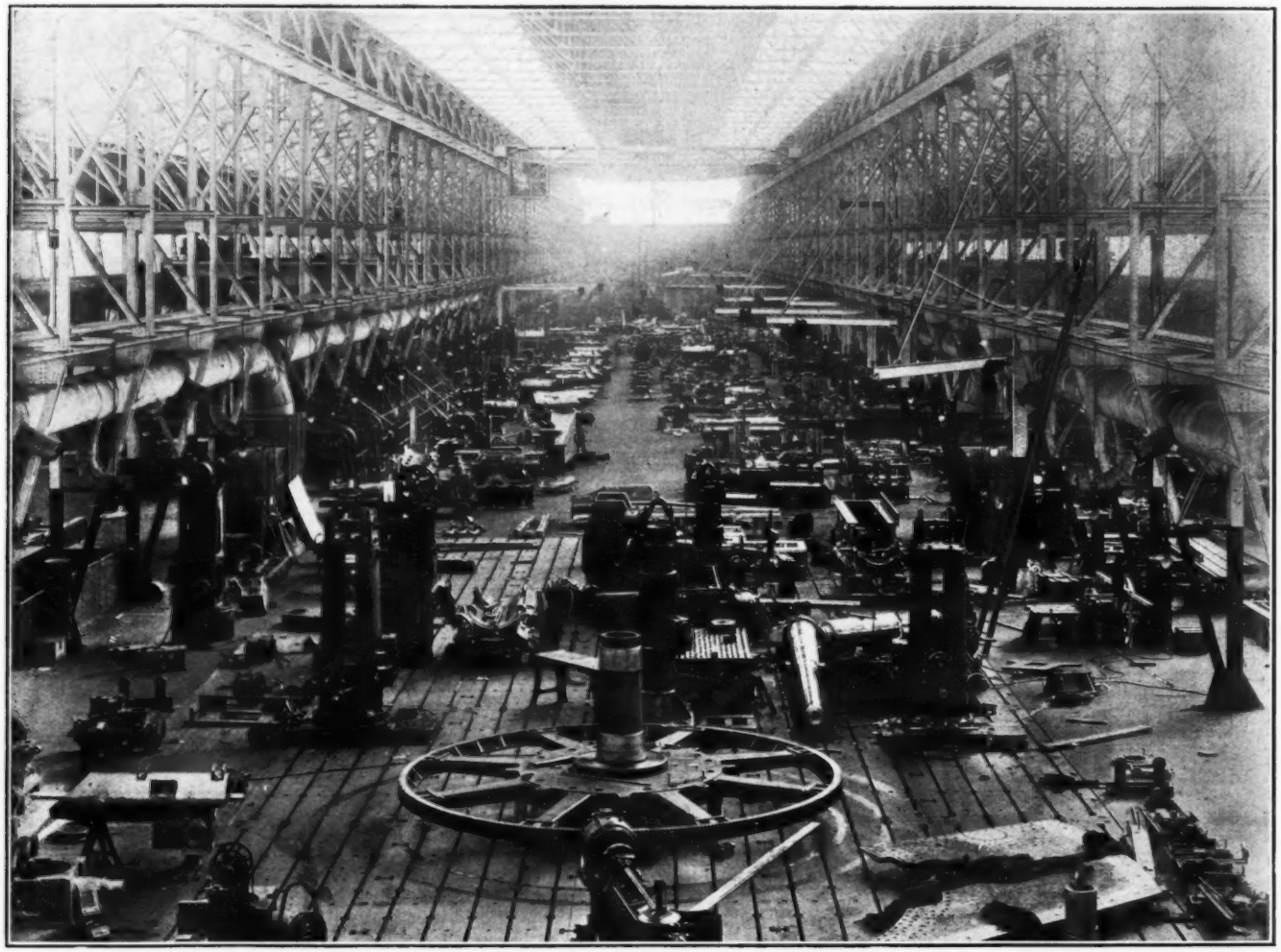

COVENTRY ORDNANCE WORKS: CENTRAL BAY OF NAVAL SHOP.

The English Electric Journal

WORKS NUMBER

DECEMBER, 1920

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Introduction.

In this volume we reprint and put on record in a more permanent form articles which have appeared in this Journal during 1920 and in which the Works of the English Electric Company at Coventry, Preston, Bradford and Stafford are described and illustrated. To these has been added an article not previously published on the remaining Works of the Company, the Willans Works at Rugby. The volume also contains a brief account of the Company's origin and of its associations at home and abroad, together with a schedule which will indicate the range of its manufactures.

The articles on the several works were written from the same point of view. The writers have endeavoured in the first place to set out briefly the past record of the Works and the part which it has had in the development of the engineering, and more particularly the electrical engineering, industry of this country. They have attempted to indicate the stages of natural growth, the manufacturing traditions, and, if the word may be allowed, the individuality of each Works. The remainder of each article has been devoted to an account of the particular function of the Works in the English Electric Company's scheme of organization and manufacture.

The outlines of that scheme may be drawn in a few lines. The Company exists primarily to develop by the most modern methods the manufacture of a wide range of electrical and allied products. Its object is to make the best use in each of its Works, not only of the equipment and the capacity of that Works, but of the knowledge and experience of them all, acquired by the effort of many minds over a generation. To do this the works at Preston, Bradford, Stafford and Rugby will, as far as possible, each be devoted to the manufacture of that class of machinery for which they are by reason of their lay-out and past history best adapted. Thus Preston will concentrate on electric traction equipment, substation plant for traction power supply, and rolling stock; Bradford on the production of standard industrial motors; Stafford on electrical plant of medium size; Rugby on steam turbines up to 5,000 K.W., condensers and internal combustion engines. The largest sizes of generating plant (steam turbines, water turbines and generators) with static transformers and small electrical apparatus and accessories are being transferred to Coventry. This programme of specialization in five works under one administrative and technical control makes for increased production and for efficiency. We are at the beginning of a new era in the history of the electrical manufacturing industry in Great Britain. The articles here reproduced will serve to indicate the angle from which the English Electric Company has approached the problem of meeting the new conditions without sacrificing any of the experience of the past.

The Origin and Associations of the English Electric Company, Limited.

THE ENGLISH ELECTRIC COMPANY, which was incorporated in 1918, represents under a new name the consolidation of a number of old and familiar interests. It controls and operates under one management—

The Dick, Kerr Works, Preston,
The Ordnance Works, Coventry,
The Phœnix Works, Bradford,
The Siemens Works, Stafford, and
The Willans Works, Rugby.

With the exception of the Ordnance Works, all these are well known as pioneers of the electrical industry in various branches.

The acquisition of the Coventry Ordnance Company, Limited, by exchange of shares with the former proprietors, Messrs. John Brown & Co., Limited, and Messrs. Cammell Laird & Co., Limited, not only gives a close alliance with these powerful groups, but avoids the necessity of erecting and equipping, at abnormal expense and with great delay in valuable time, new shops to deal with the increased demands for electrical and allied machinery. The shops at Coventry, which were designed for the production of the largest class of naval ordnance, are eminently suited for manufacture of heavy electrical machinery and steam and water turbines of maximum size. The fact that over 11,000 people were employed during the war period indicates the capacity of the plant.

ASSOCIATIONS.

For the expansion and consolidation of the Company's interests certain associations have been arranged and others are under consideration.

Siemens Bros. & Co., Limited.—There is a working arrangement which gives preferential supply of cables and apparatus that may be required in carrying out comprehensive contracts.

English Electric & Siemens Supplies, Limited.—This is jointly controlled by the English Electric Company and Siemens Bros. for the marketing of the supply products of the two Companies.

Consolidated Construction Co., Limited.—The general contracting departments of Dick, Kerr & Co. and J. G. White & Co. have been amalgamated under this name, and the combined experience of their staffs is available for dealing with complete installations of steam or hydraulic plants, power transmission lines and electric railway equipment.

Les Constructions Electriques de France and **Les Constructions Electriques de Belgique**, each with a capital of 40 million francs, are in close association with each other and with the English Electric Company, and occupy an important position in the electrical industry of Western and Southern Europe. They hold the manufacturing rights of the English

Electric Company for France and Belgium, and act as agents for that Company in France, Belgium, Italy, Luxembourg, Holland, Spain, Portugal and Poland, and in the Colonies and Dependencies of those countries.

Les Constructions Electriques de France have succeeded Les Constructions Electriques du Rhône, the former Agents of Dick, Kerr & Co., Ltd. They have acquired the well-known Water Turbine business of **Les Etablissements Singrun of Epinal.** In addition to works near Lyons, now approaching completion, and laid out for the manufacture of tramway rolling stock, electric traction equipment and general electrical machinery, they are erecting new works at Tarbes, in the Pyrenees Province, specially designed for the manufacture of hydraulic turbines, electric locomotives, and heavy electrical machinery.

Les Constructions Electriques de Belgique have absorbed the **Compagnie Internationale d'Electricité,** of Liège, and the **Anciens Ateliers de Constructions van den Kerchove,** of Ghent—the former well known as manufacturers of general electrical plant, and the latter of steam engines and steam turbines. A new works is being built at Liège for the production by the most modern methods of the smaller classes of electrical machinery, and the works in Ghent will also shortly be extended.

Toyo Denki Seizo Kabushiki Kaisha.—This Company holds the rights for the Japanese Empire to manufacture D.K. traction equipment in their works situated near Tokio. It is in close relations with the English Electric Company's Branch Office in Japan.

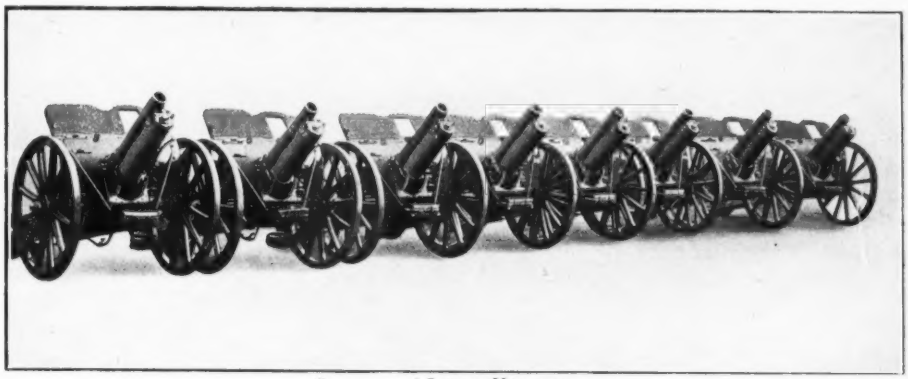
English Electric Company of Australia, Limited.—This Company represents the alliance and extension of two well-known Australian manufacturing Companies—the Standard Waygood Hercules, Limited, of Sydney, and G. Weymouth Proprietary, Limited, of Melbourne—both engaged in the manufacture and sale of electrical and allied machinery. The new Company, which has a capital, locally subscribed, of £600,000, will develop manufacture in Australia, to the designs of the English Electric Company, and act as Australian representative. New works near Sydney are at present being built and equipped with the most modern plant.

SCHEDULE OF MANUFACTURES OF THE ENGLISH ELECTRIC COMPANY, LIMITED.

Electrical Generating Plant of all capacities.
Steam Turbines and Condensers.
Water Turbines and Impulse Wheels.
Internal Combustion Engines.
Rotary Converters.
Static Transformers.
Switchgear and Controlling Apparatus of all kinds.
Electric Locomotives.
Electrical Equipment and Rolling Stock for Railways and Tramways.
Electric Plant for Rolling Mills, Iron, Steel, Copper Works, etc.
Electric Winding Equipments for Mines.
Standard Industrial Motors.
Incandescent Lamps, Domestic Heating Apparatus and Electrical Accessories.

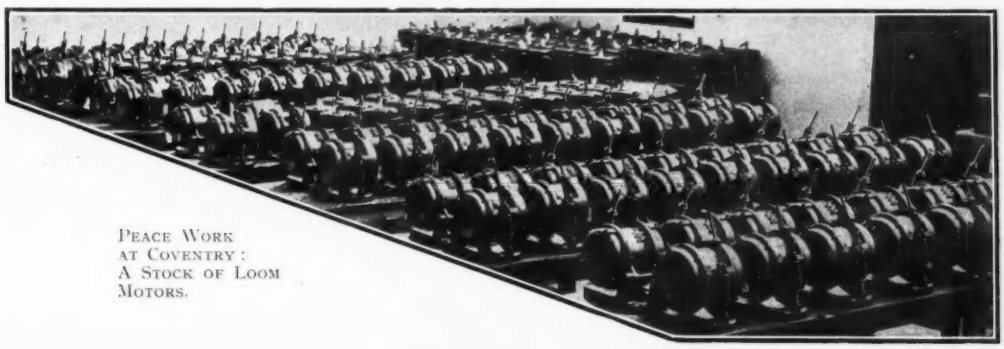
The Coventry Ordnance Works

(*January, 1920.*)



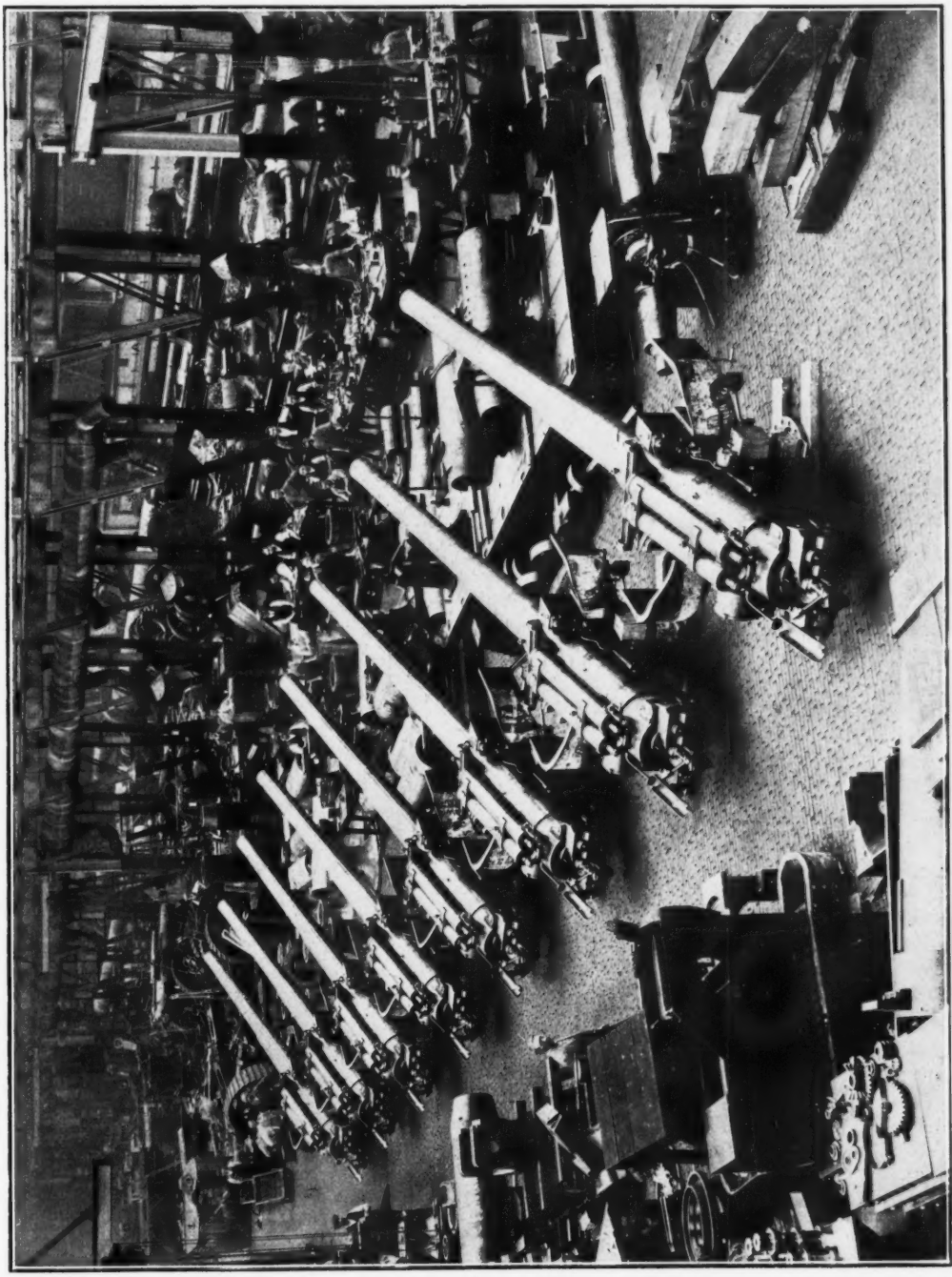
GROUP OF 4·5-INCH HOWITZERS.

In the group of manufacturing concerns which has come under the control and management of the English Electric Company none is more important than the Coventry Ordnance Works. The works at Coventry cover a greater area than those of any other member of the group. They were specially designed and equipped to deal with armaments on the gigantic scale of modern times; and this design and equipment, converted to civil purposes, are an invaluable asset in these days when the most striking tendency of electrical manufacture is towards the production of machinery heavier and more powerful than ever before. There can be no better indication of the part which the Coventry Ordnance Works may be expected to fill in the development of the organization of the English Electric Company than the record of what they have accomplished in the past. We propose, therefore, in this first number of the English Electric Journal, to give a brief sketch of the history of



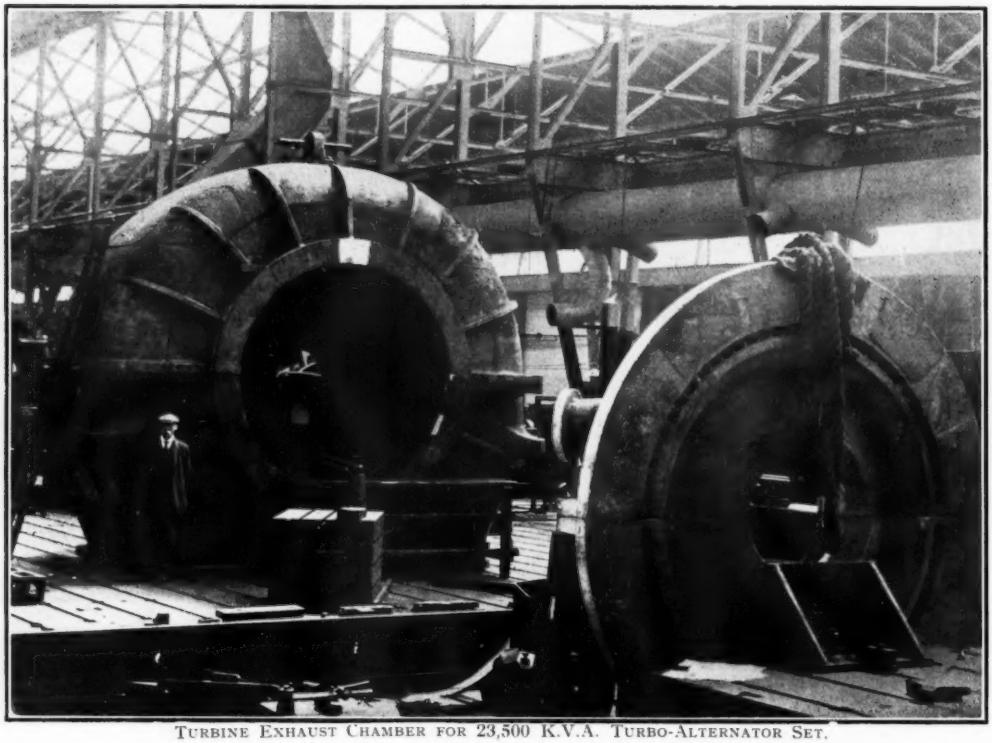
PEACE WORK AT COVENTRY: A STOCK OF LOOM MOTORS.

13·5-INCH GUNS IN COURSE OF CONSTRUCTION.



5 5-INCH NAVAL GUNS AND MOUNTINGS.

PEACE WORK AT COVENTRY ORDNANCE WORKS.

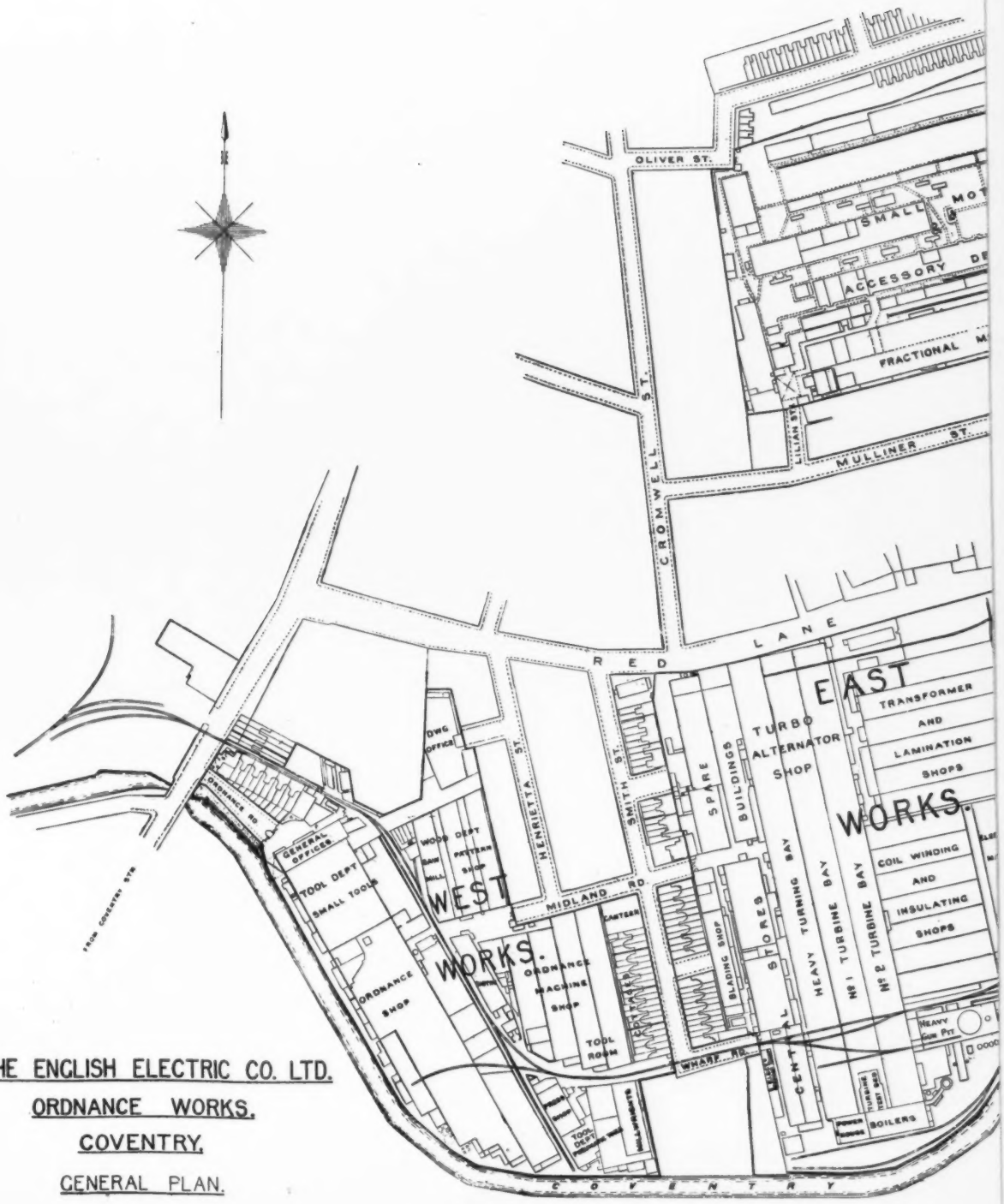


TURBINE EXHAUST CHAMBER FOR 23,500 K.V.A. TURBO-ALTERNATOR SET.

the Coventry Ordnance Works, their record in the War and the manner in which they are being converted to the new tasks of peace.

THEIR HISTORY.

Few great businesses can have grown to such dimensions in so short a time from such modest beginnings. The Coventry Ordnance Works were founded as a private venture by a Birmingham waggon builder, in order to meet the unusual demand for artillery wheels during the Boer War. This original product of the firm was retained, and during the recent war the Coventry Ordnance Works manufactured over 125,000 Artillery Wheels, far more than any other factory in the United Kingdom. From Artillery Wheels the Works were led by a natural transition to the manufacture of guns, at first on a very small scale. In 1905 the business was acquired by the three great Armament and Shipbuilding Firms of John Brown, Cammell Laird, and the Fairfield Shipbuilding Company, and from that date was rapidly developed as an essential part of their organization for the manufacture of modern engines of war. At Coventry the new Company specialized in the manufacture of guns of all calibres up to the heaviest naval guns, of gun carriages and mountings, and, in a separate factory, fuzes. Works were built at Scotstoun, on the Clyde, for the production of garrison and barbette mountings for heavy guns, and a large dock was constructed at the works for the shipment of gun machinery which was too large and too heavy for rail transport. Thus, during the years before the war, an organization was



THE ENGLISH ELECTRIC CO. LTD.

ORDNANCE WORKS.

COVENTRY.

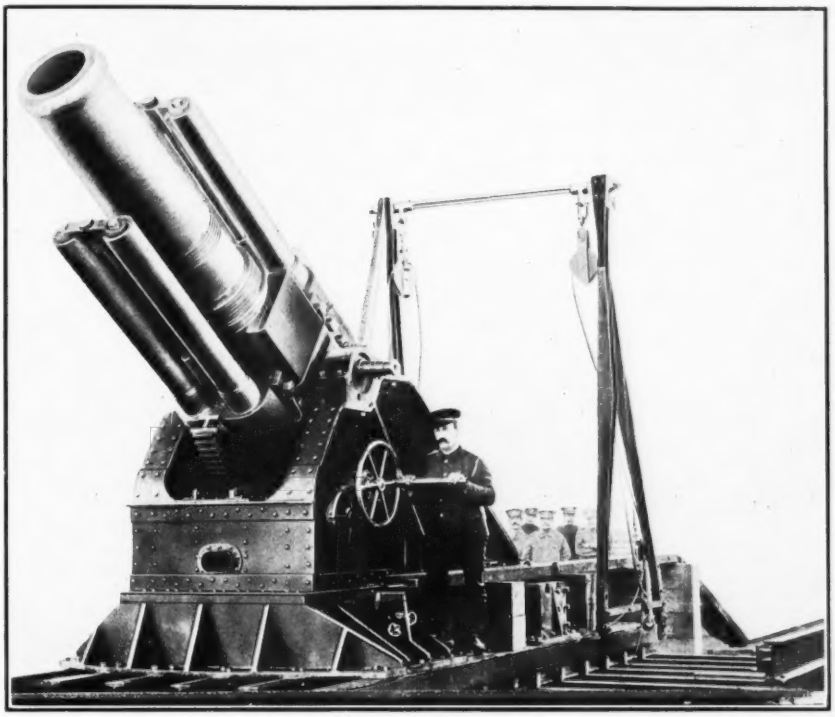
GENERAL PLAN.

OLIVER ST.
CROMWELL ST.
LILIAN ST.
RED LANE
DWG OFFICE
HENRIETTA ST.
SMITH ST.
SPARE BUILDINGS
TURBO ALTERNATOR SHOP
GENERAL OFFICES
TOOL DEPT
SMALL TOOLS
ORDNANCE SHOP
WEST WORKS.
MIDLAND RD.
ORDNANCE MACHINE SHOP
TOOL ROOM
CARTERS
STORES
HEAVY TURNING BAY
No 1 TURBINE BAY
WHARF RD.
COVENTRY

IC CO. LTD.

RKS.

SMALL MOTOR
ACCESSORY DEPT.
FRACTIONAL MOTOR DEPT
MULLINER ST.
AST
TRANSFORMER
AND
LAMINATION
SHOPS
HEATER
SHOP
WORKS
COIL WINDING
AND
INSULATING
SHOPS
ELECTRICAL
MACHINE
SHOP
No 1 TURBINE BAY
No 2 TURBINE BAY
HEAVY
GUN PIT
BOILERS
C A N A L
100 50 0 100 200 300 400 500 600
FEET



15-INCH HOWITZER.

developed and perfected which could be placed at the service of the country without loss of time or efficiency when war broke out.

THEIR WAR RECORD.

The value of that organisation was illustrated during the earliest days of the war, long before the public had heard of any shortage of munitions. In September, 1914, our troops in France began to feel the urgent need of mobile heavy artillery, to counteract the effect of the heavy howitzers then being used by the Germans. At Coventry a new 15-inch Howitzer was designed to meet this need. Both in size and in design it went far beyond all previous British standards. Special tractors were constructed to transport it by road. The work was pressed on with such energy that in January, 1915, the first shot was fired on the trial range, and three months later the Howitzers were being successfully used at the front.

During the war the Coventry Works produced twenty-four different types of guns and howitzers. The number of some of the more important types will indicate what this meant. Of the 15-inch and 13·5-inch Naval guns there were 23, of 12-inch Howitzers 39, of 6-inch Howitzers 465, of 5·5-inch guns 58, of 4·5-inch Howitzers (a type designed and perfected at Coventry before the war) 2,490, of 4-inch guns for arming merchant vessels 191, of 12-pounder guns 522. Shortly before the armistice, arrangements had been made to produce on a large scale a $1\frac{1}{2}$-pounder automatic gun specially designed at Coventry for use on aircraft.

Simultaneously with this vast production of guns, the works were engaged in many other branches of armament and munitions manufacture. None was more important than the Naval work. Since 1913, Coventry and Scotstoun

have been responsible for the main armament of the super-Dreadnoughts H.M.SS. Benbow and Royal Sovereign, of the battle-cruiser H.M.S. Renown, and of the monitors H.M.SS. Lord Clive, Prince Eugene, General Crawford, Abercrombie, Havelock, Raglan, and Roberts; for the armaments of forty of H.M.'s Cruisers, of seventeen of H.M.'s Flotilla leaders and Torpedo Boat Destroyers, and of twenty-three Submarines.

In the Fuze Factory at Coventry the war production included seven million time and percussion fuses, two-and-a-half million High Explosive fuses and gaines, seven million friction tubes, two million primers for cartridges, and sixteen million fuze detonators. The production of gun sights steadily rose from 1,200 in 1917 to over 3,000 in 1918. More than 600 aeroplanes were constructed, of the Snipe, R.E.8., B.E.12A., R.E.7 and other types.

The enumeration of figures is in itself a cold and unsatisfying method of description. But it needs little effort of the imagination to see behind figures such as these some glimpses at least of the human energy and enterprise with which the Coventry Ordnance Works faced the engineering problems of the country during the war.

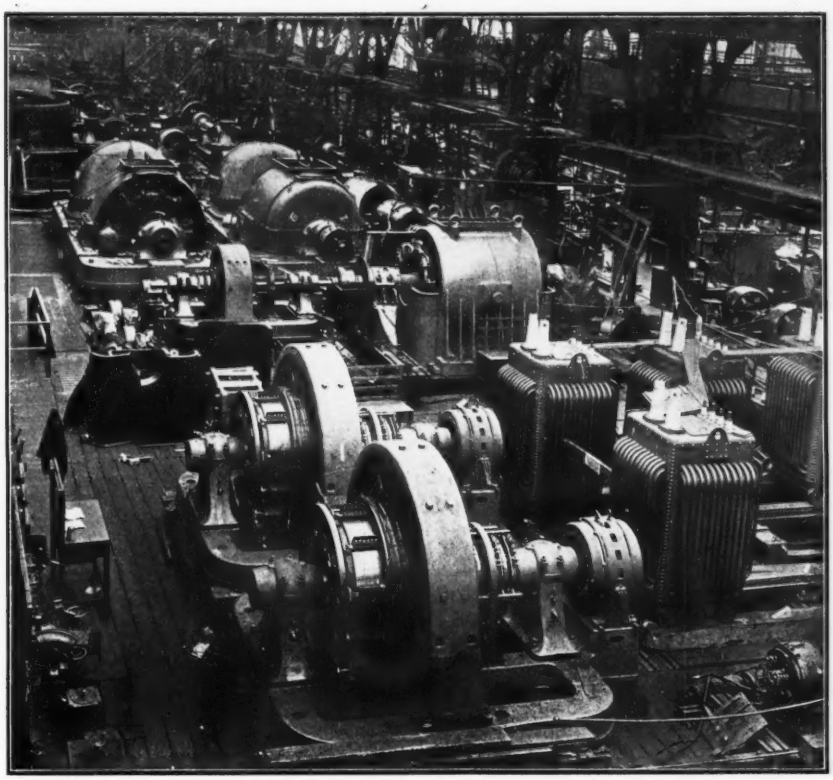
The Future.

Those qualities are now being devoted to the task of converting the works to the productive activities of peace. A nucleus for the armament industry is necessarily being maintained. The future alone can show how far it will be required; but, as long as the disarmament of the world is relative and not absolute, it is plainly essential in the national interest that some part of an organization such as the Coventry Ordnance Works should be maintained. But in future by far the greater part of the productive capacity of Coventry will be occupied in the manufacture of electrical and allied machinery. The main works at Coventry are suited for dealing with the heaviest types. They have vast floor space—the naval shop alone is almost 1,000 feet long—and great crane capacity, with elaborately equipped machine shops. The wide electrical experience and designing knowledge of the group as a whole has been enlisted with a view to the manufacture in these shops of the largest steam turbines, electric generating machinery, rolling mill motors and winding gear. We reproduce in this issue a photograph of part of one of the 18,000 K.W. Turbine sets now being manufactured at Coventry for the new Dalmarnock Power Station of the City of Glasgow. The fuze factory has been converted to the manufacture of small electrical apparatus, such as Loom Motors, of which we print an illustration, electric fires and other domestic appliances—all eminently fitted for production in mass. Large sums have been spent at Coventry on the purchase of buildings and plant from the Ministry of Munitions, and on additions to and improvements in the equipment of the shops which will facilitate their conversion to electrical work.

Automatic Gun: 1½-Pounder, for Mounting on Aircraft.

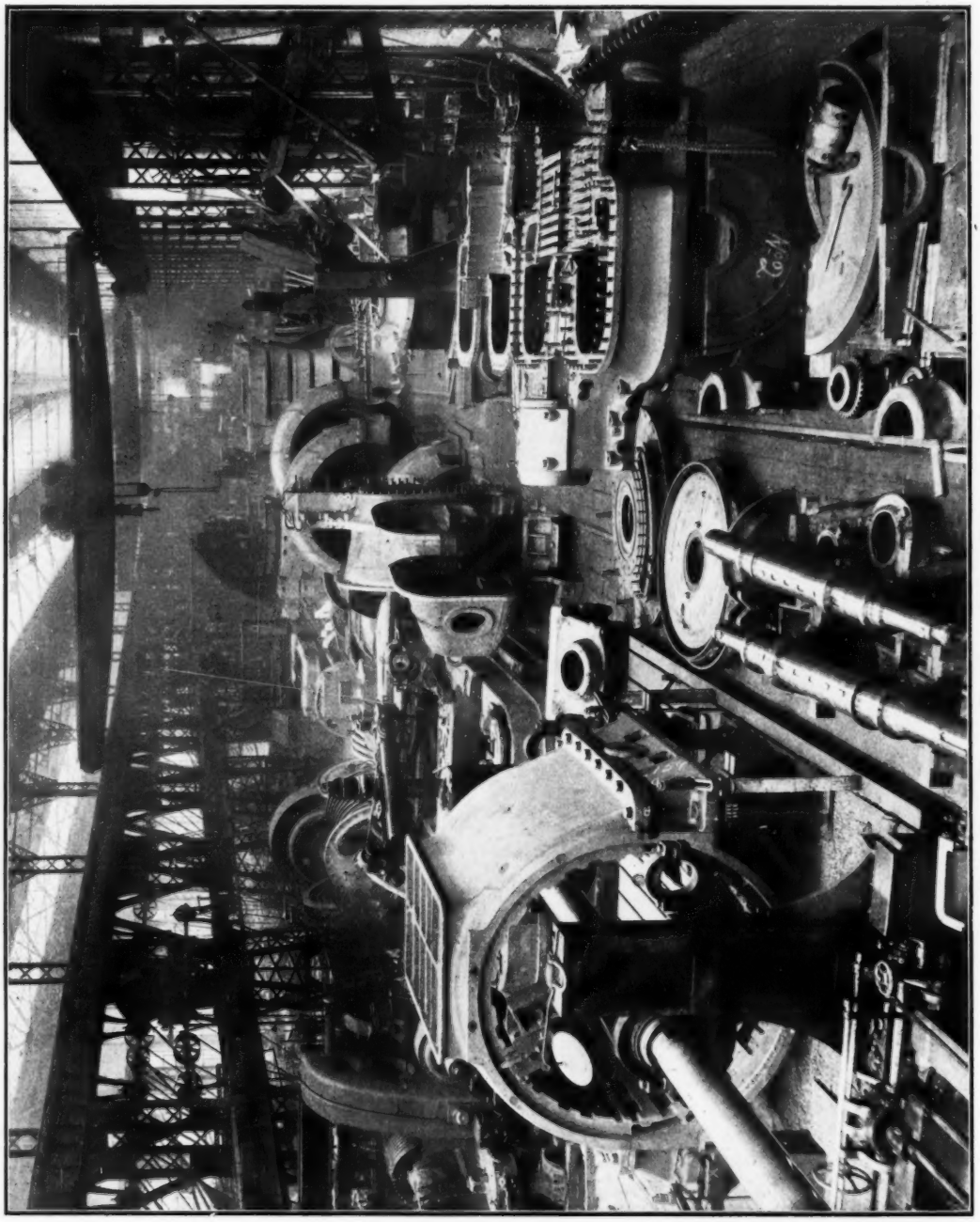
The Dick, Kerr Works, Preston.

(April, 1920.)



PRESTON WORKS: PART OF THE TEST-BED.

The Preston works here broadly described, and illustrated are contemporaneous with the rise of electricity as applied to motive power for local transport and industrial machinery; but the firm of Dick, Kerr & Co. has a longer history, and affords in that respect an interesting example of technical and commercial adaptation. The circumstances in the period immediately



DICK, KERR WORKS, PRESTON: HEAVY BAY IN THE MAIN SHOP.

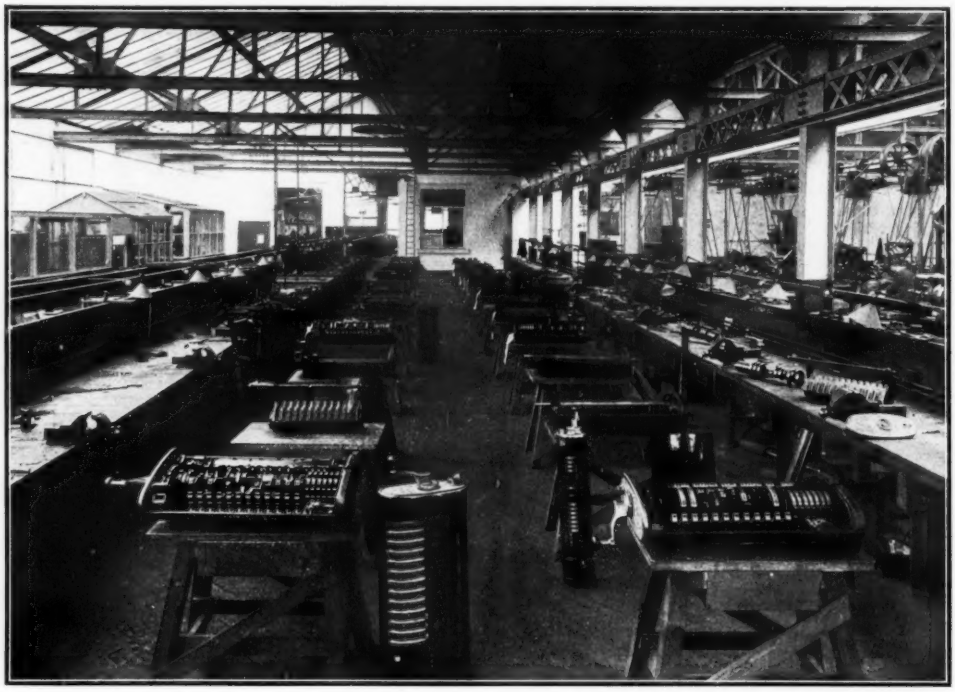
preceding the introduction of electricity are therefore of special interest in this case, as showing how to some extent electric traction came in natural succession to other means of town transit, and how Dick, Kerr & Co. had the initial advantage of entering the era of electrification with much valuable experience of public works of a kindred character.

PRESTON WORKS: TRACTION MOTOR DEPARTMENT.

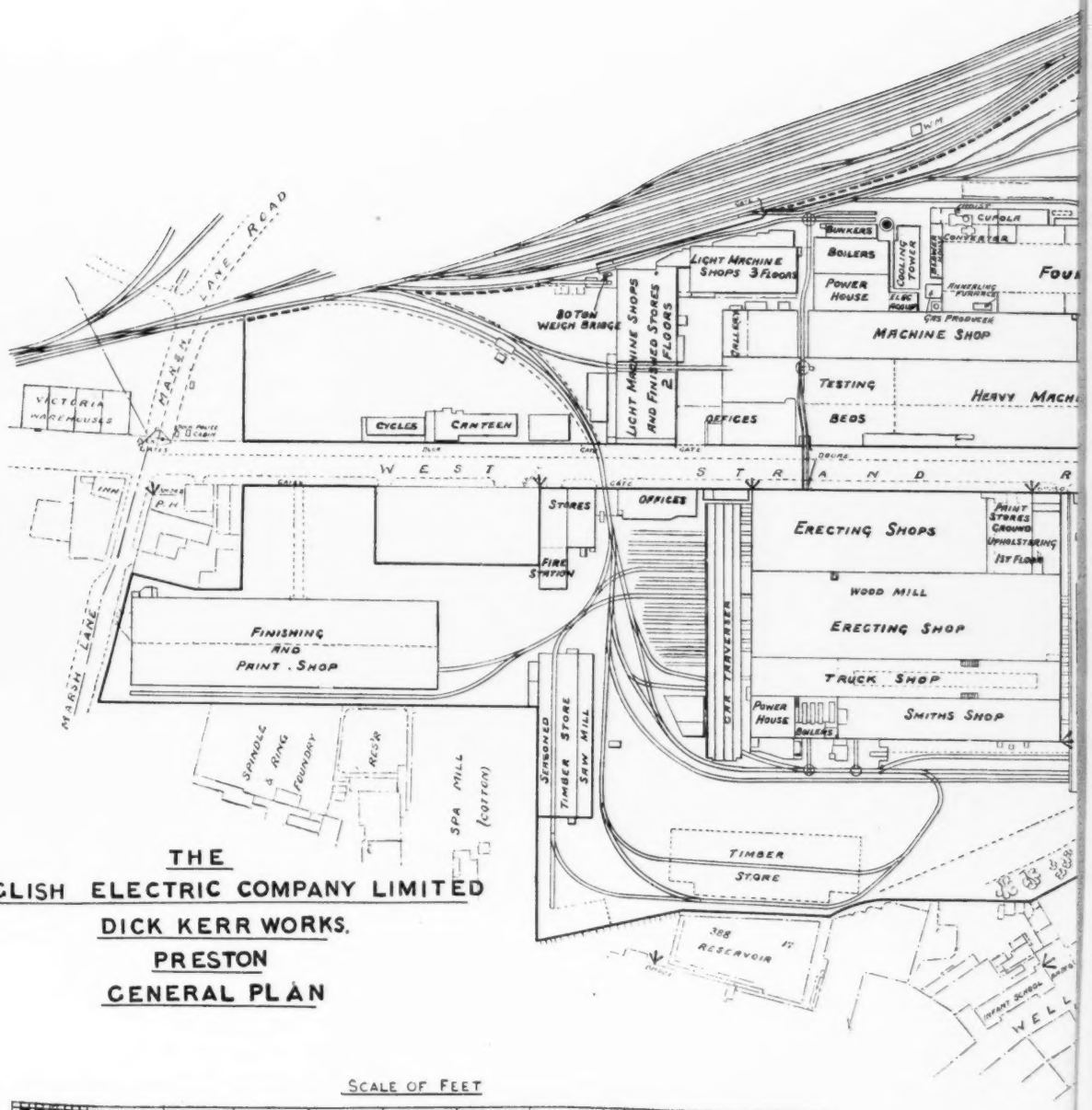
In the early eighties, long before their association with Preston began, Dick, Kerr were the first British firm of engineering contractors to specialize in the laying and equipment of tramways They did much in those days to assist in the introduction of the grooved girder tram rail, which has now become universal. As the need was seen of some form of mechanical traction, they built steam locomotives for the haulage of tramcars along street tracks. Although the system served its purpose, the objections to it were obvious, and led to attempts to find in other directions a solution of the problem of street traction. San Francisco was the birthplace of the system of endless cable haulage as adapted to street traction, the system being introduced there by a Scotch engineer. The example was successfully followed in New York, Chicago, and other places in the United States; and in 1887 Dick, Kerr constructed the first section of the endless cable tramway system in Edinburgh, a city built, like San Francisco, on many hills. However well adapted to the natural conditions of these towns in which it flourished, endless cable haulage could not, owing to its want of flexibility, in the long run contend against the

advance of electricity as a universal motive power in street traction. From the beginning Dick, Kerr were pioneers in the construction of electric tramways in this country. In the year 1887 they built the first electric conduit line in the world, that from Gravesend to Northfleet, and this was followed by many other electric installations.

So it was that in 1897, when the day of electric traction had dawned, they bought works at Preston, brought them up-to-date and extended them for the manufacture of electric tramway cars. The business was managed by a separate company, known first as the Electric Railway and Tramway Carriage Works, Ltd., and later as the United Electric Car Co., Ltd. At that time it was the general practice to import the electric equipment from abroad. In the year 1900, however, the management of Dick, Kerr & Co. felt that the electric railway and tramway business in this country was firmly established, and that the electrical equipments could be manufactured here on a large scale. So they acquired a piece of vacant ground adjoining the Car Works, and on that site new works for general electrical manufactures were erected by the English Electrical Manufacturing Co., Ltd., formed for that purpose. The company obtained the services of Professor Sidney H. Short, who had already made a world reputation, first as the founder of the Short Electric Company of Cleveland, Ohio, and subsequently as the chief engineer and designer of the Walker Electric Company, of the same town. The new undertaking was a success from the beginning, and the products of the Preston Works, more particularly the motors and control equipment of railway and tramway rolling stock, became known and were in demand in all parts of the world. A few years after its formation the



Traction Controller Assembling Shop.



THE ENGLISH ELECTRIC COMPANY LIMITED

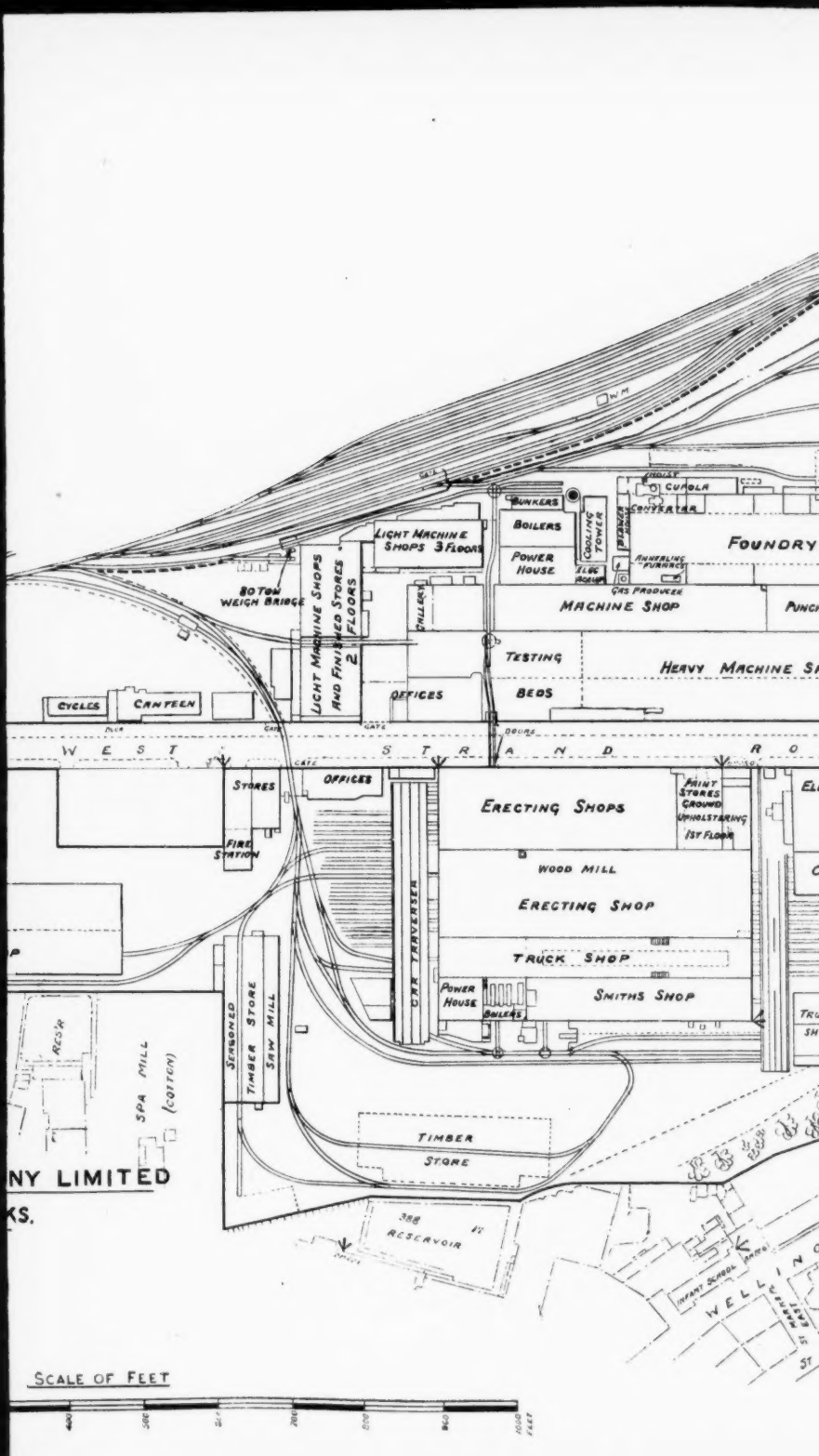
DICK KERR WORKS.

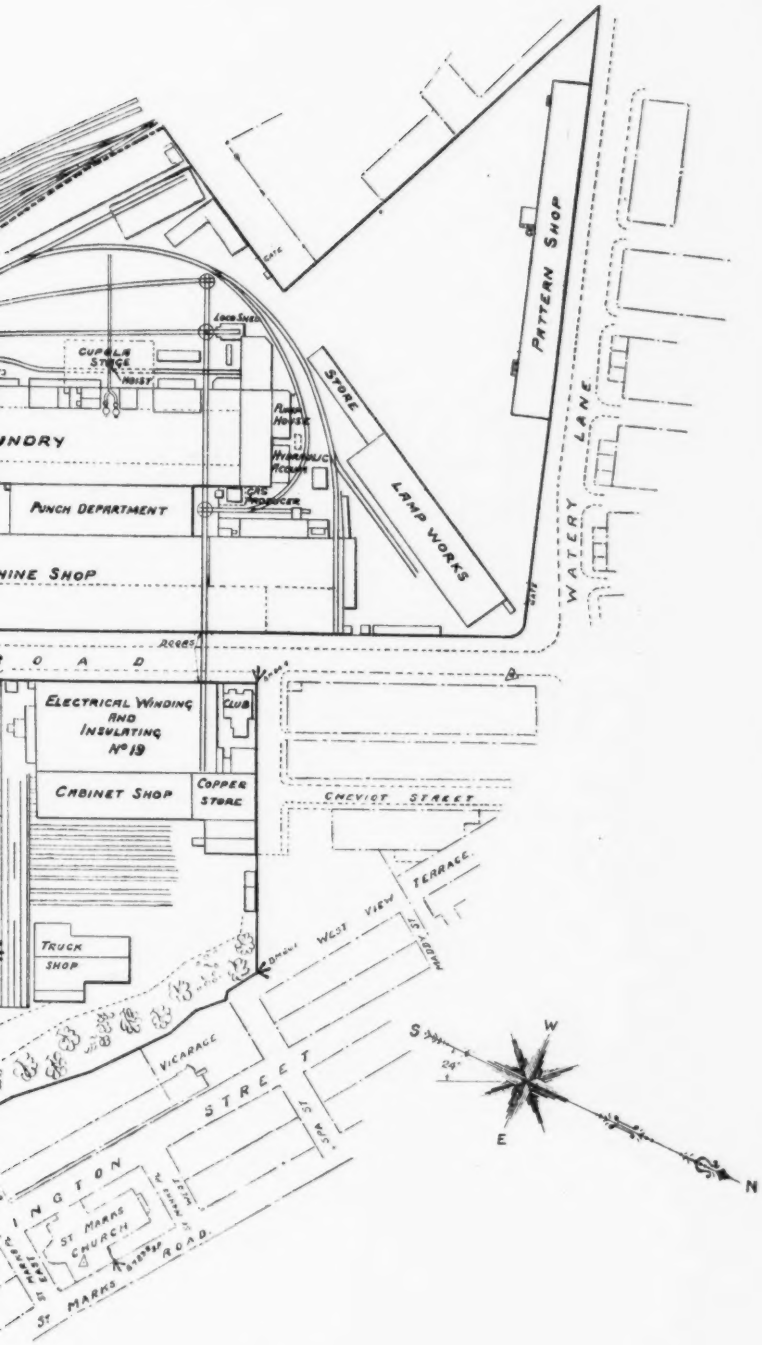
PRESTON

GENERAL PLAN

SCALE OF FEET

0 100 200 300 400 500 600 700 800 900 1000

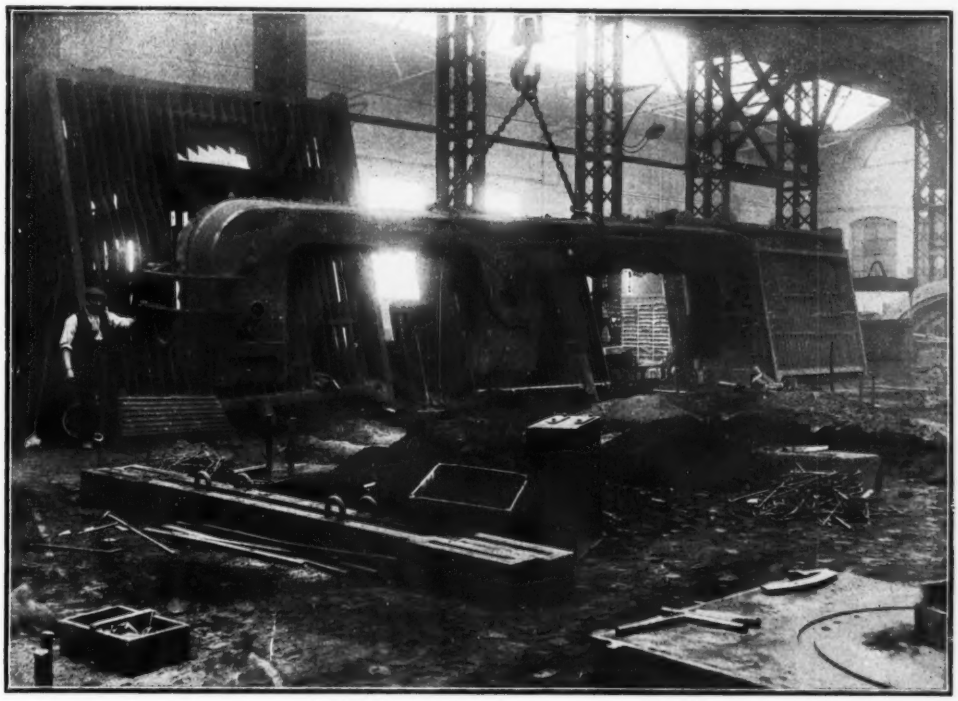

W M
GATE
BUNKERS
BOILERS
POWER HOUSE
COOLING TOWER
CHIMNEY
CUPOLA
CONVERTER
ANNEALING FURNACES
GAS PRODUCER
FOUNDRY
LIGHT MACHINE SHOPS 3 FLOORS
LIGHT MACHINE SHOPS AND FINISHED STORES 2 FLOORS
GALLERY
80 TON WEIGH BRIDGE
MACHINE SHOP
TESTING BEDS
HEAVY MACHINE SHOP
OFFICES
CYCLES
CANTEEN
GATE
DOORS
W E S T S T R A N D R O
STORES
OFFICES
FIRE STATION
ERECTING SHOPS
PAINT STORES GROUND UPHOLSTERING 1ST FLOOR
WOOD MILL
ERECTING SHOP
TRUCK SHOP
SMITHS SHOP
POWER HOUSE
BOILERS
C.M.R. TRAVERSER
SEASONED TIMBER STORE
SAW MILL
SPA MILL (COTTON)
REPAIR
TIMBER STORE
388 RESERVOIR
INFANT SCHOOL
PARK
WELLINGTON
ST
NY LIMITED
KS.
SCALE OF FEET
100
200
300
400
500
600
FEET


PATTERN SHOP
WATERY LANE
STORE
LAMP WORKS
CUPOLA STAGE
HOIST
LOCO SHED
FAN HOUSE
HYDRAULIC ACCUMS
GAS PRODUCER
PUNCH DEPARTMENT
ELECTRICAL WINDING AND INSULATING No 19
CLUB
CABINET SHOP
COPPER STORE
CHEVIOT STREET
TERRACE
WEST VIEW
TRUCK SHOP
VICARAGE
STREET
ST MARKS CHURCH
ROAD
ST MARKS
S
W
E
N

English Electrical Manufacturing Company was absorbed into Dick, Kerr & Co., by an exchange of shares. The Car Company remained separate, but close relations existed which enabled Dick, Kerr to deliver completely equipped tramway cars without the disadvantage of having to assemble them at their destination. Since 1917 financial control of the United Electric Car Company has drawn the bonds between the two works closer, and the Car works for all practical purposes now form part of the organization of the Dick, Kerr Works, Preston. The plan which we print will indicate the extent and capacity of the works to-day. The total area of the property is 32½ acres, of which 14 acres are under roof. The total floor space is approximately 700,000 square feet.

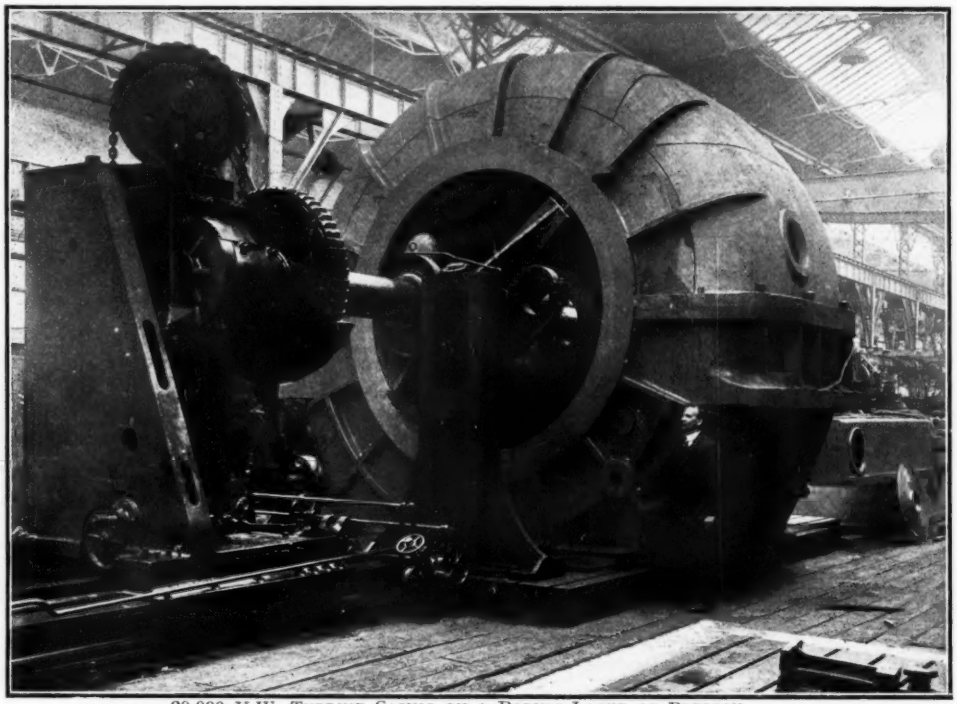
Preston is a town of interesting historical and industrial associations, possessing exceptional advantages for manufactures of this character. The works are situated in close proximity to the Preston Docks, and thus have excellent facilities for handling both raw material and finished products, either by sea or by rail, the docks naturally being amply supplied with railway sidings and connections with both the London and North Western and the Lancashire and Yorkshire Railways.

The two works are separated by a public highway, which is a decided advantage, in that it creates a permanent barrier between the woodworking department and the engineering shops. As will be seen from the plan, the main machine shop runs parallel to the street, and consists of two bays, each 900′×60′, and equipped with cranes ranging to 50 tons individual capacity. At the northern end there is direct communication with the foundry, and the machinery in the shops is arranged so that there is a continuous progression until the



A View in the Foundry.

finished article arrives at the test beds. Running parallel to the main machine shop is another shop of similar length, part of which is devoted to the punching of laminations, while the rest is equipped specially for the machining and assembly of traction motors. Lying to the south and west of these main machine shops are two buildings, one of three stories, and the other of two stories, having a total floor area of 50,000 sq. ft., which were erected during the war for the production of shells, but which have now been converted into light machine shops for the production of the component parts of traction motors and controllers and control equipment.



20,000 K.W. Turbine Casing on a Boring Lathe at Preston.

The foundry is a building of 500′×110′, the greater portion of which is devoted to the production of iron castings, but a section is specially laid out as a steel foundry for traction motor casings.

In the past a large variety of electrical machinery has been turned out in these works, but it is now the intention to specialize on traction apparatus generally, and certain classes of generating and sub-station plant of intermediate sizes, the heavier classes being transferred to the Ordnance Works, Coventry, and the lighter classes to the Phœnix Works, Bradford, while the Siemens' Works at Stafford will specialize in intermediate sizes of other types of machinery.

The policy of local manufacturing specialisation adopted by the English Electric Company thus provides for the first time in electrical history a large works devoted primarily to complete traction equipment, at which technical study and manufacturing skill will be concentrated on research and improvement and increased output in this department of electrical progress. Improvements, both in design and in methods of production, have already been attained by this concentration, and the Preston plant is in every way prepared to play its part in the coming period of general electric railway extension.

Notable among the products of the Dick, Kerr Works in the past, in addition to some 650,000 H.P. of traction motors distributed over many

systems at home and abroad, are the complete powerhouse and sub-station equipment of the Liverpool-Southport Railway, the first main line electrification in this country; and the similar equipment of the Manchester-Bury main line supplied in 1914, the first 1,200-volt, third rail equipment put into operation. In generating plant the products of the Preston Works are found in all parts of the world. In Japan they are represented by the six 7,775 k.v.a. generators of the Inawashiro Power Company, supplying Tokyo at a distance of 120 miles and a transmission voltage of 100,000. In British-Columbia we find three 8,900 k.v.a. generators supplying the power for the City of Vancouver. In Australia the main power supply of the New South Wales Government Railway is derived from Dick, Kerr generators coupled to Willans' turbines. At the present time in the works are to be found turbines and generators of 20,000 k.w. capacity for the new Dalmarnock Station of the Glasgow Corporation, and the turbo-generator sets of 10,000 k.w. for the new Blackburn Corporation Powerhouse, the first of the so-called Super Stations.

At the north end of the Main Machine Shop is a four-storey building where the manufacture of incandescent lamps is carried on. These are marketed as the Britannia Lamp, and the Works has a capacity of about 5,000,000 lamps per annum.

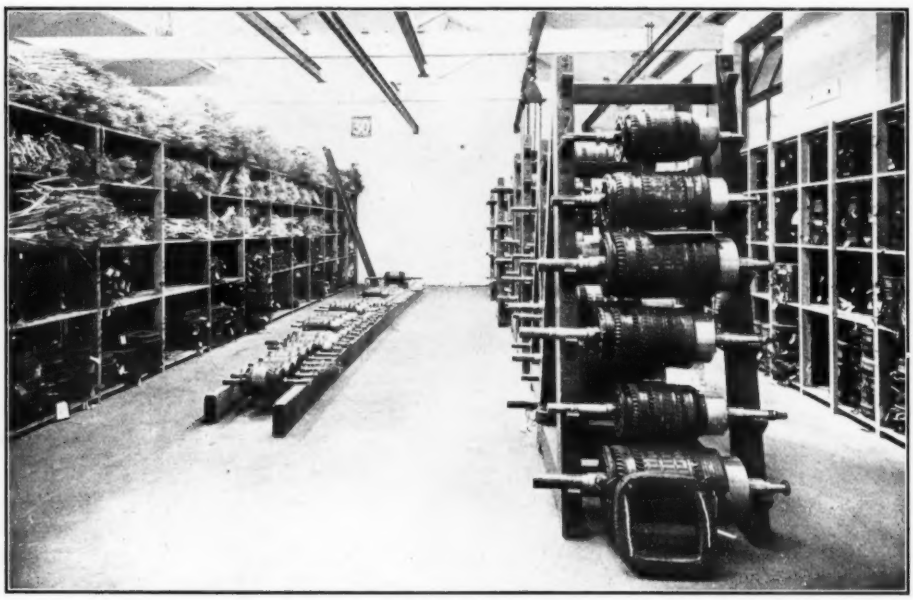
On the east side of the Strand Road the shops are devoted to the production of tramway rolling stock, except a certain space occupied by the Electrical Winding and Insulating Department, which is located here to reduce the fire risk on the engineering side of the works. The Car Works are conveniently laid out, the raw material passing through the woodworking mill, and at the end of that shop being reversed through the two erecting shops. The Finishing and Painting Shop is an entirely separate building on the other side of a wide yard, thus being entirely isolated from the dust of the mill. The Truck Shop has a capacity in proportion to the output of cars, which in normal times is some 600 per annum. The large majority of the cars leave the works completely equipped with their motors and controlling apparatus, an immense advantage to purchasers in enabling them to avoid the congestion and disorganisation of their car sheds which is inevitable when the assembly has to take place at destination.

The Company has lately purchased Ashton Park, lying about half a mile from the Works, and having an area of some 90 acres, as a War Memorial, and proposes to convert the Manor House into a Social Club for the workpeople. Football grounds have already been provided, and there is ample space for other sports grounds.

THE CLUB HOUSE, ASHTON PARK.

The Phoenix Works, Bradford.

(July, 1920).



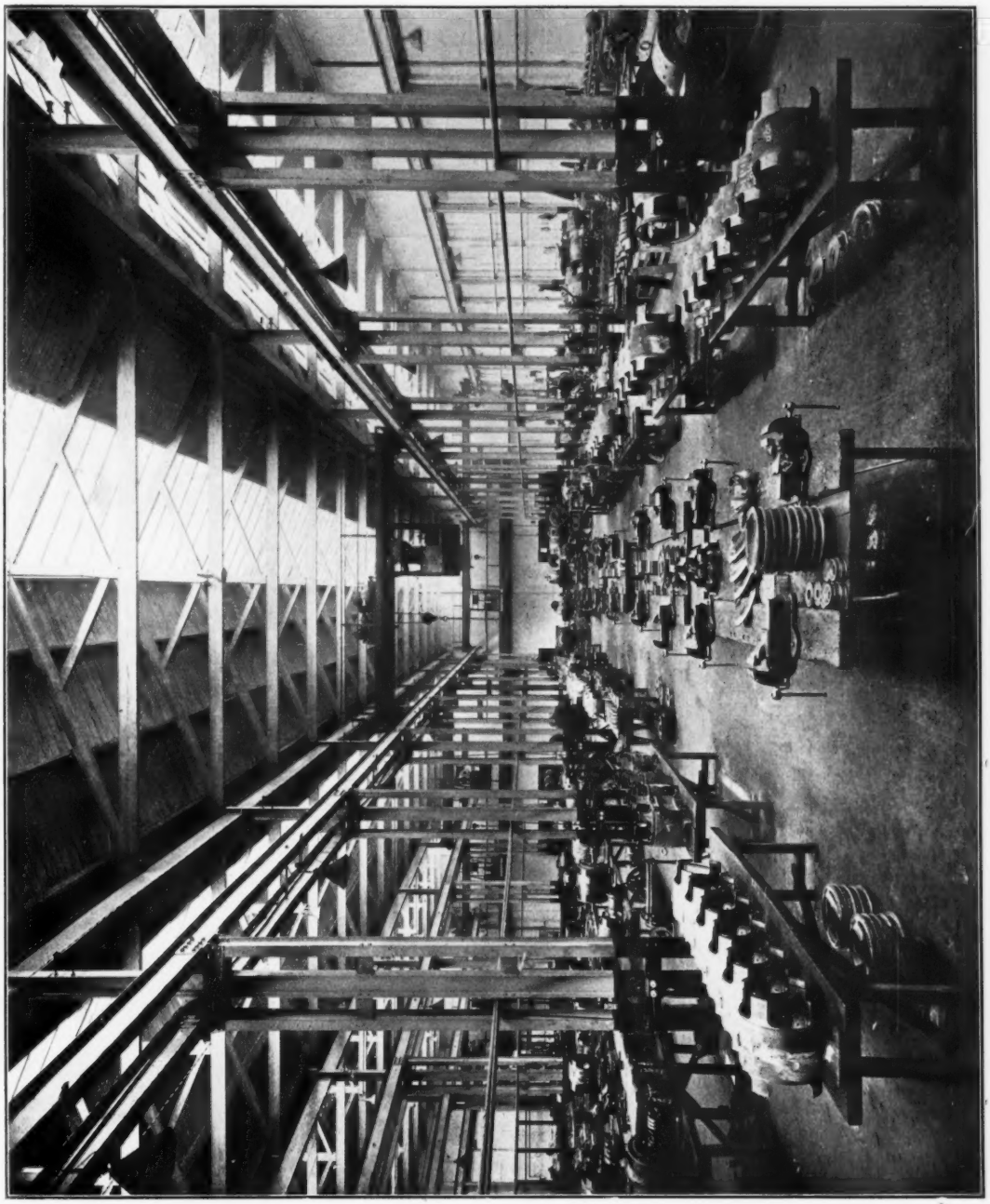
WINDING STORES.

IN THE PAST.

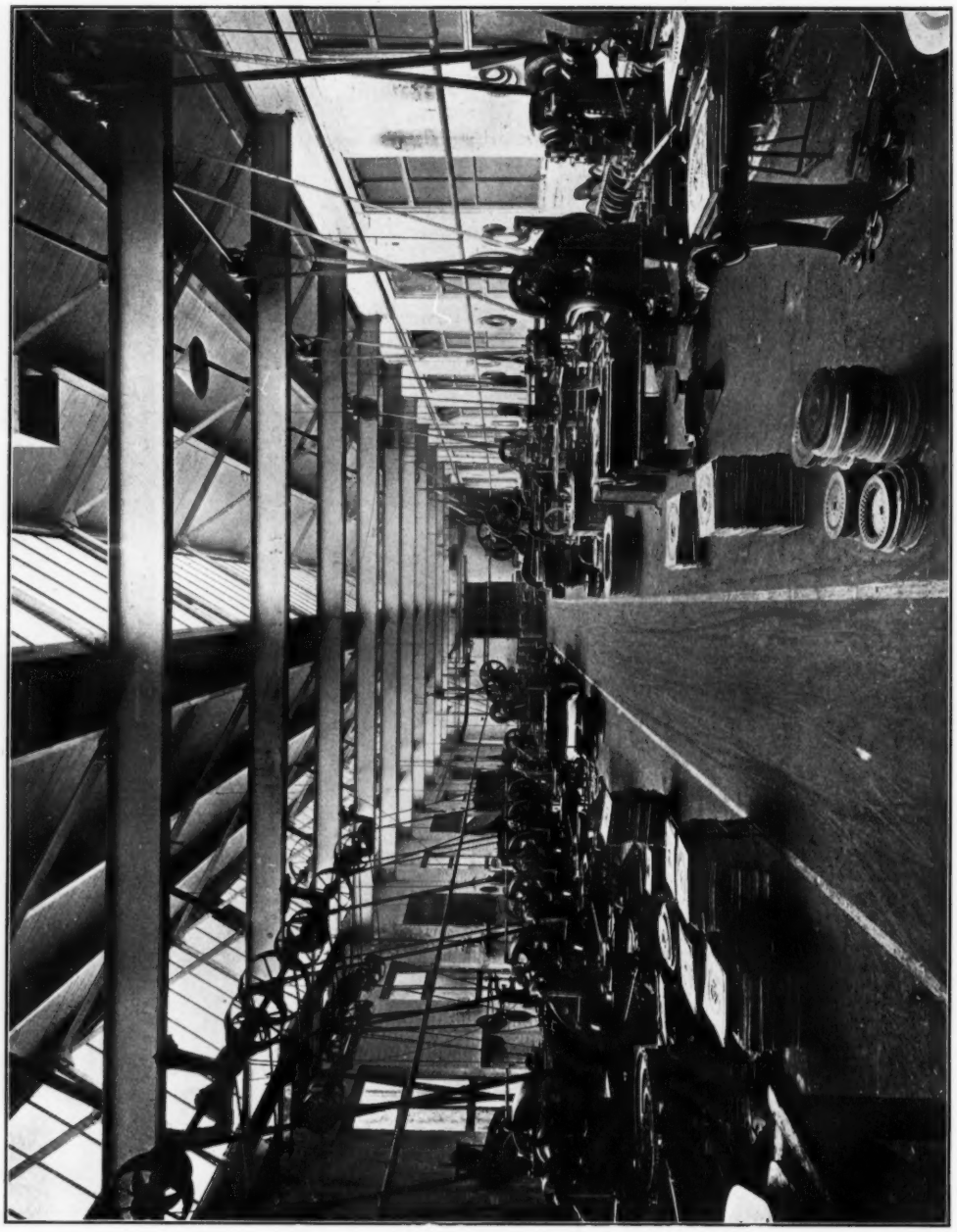
The Phœnix Works of the English Electric Company are situated at Bradford. From their inception, over twenty years ago, they have been planned for, and occupied with, the manufacture of the smaller classes of rotating electrical machinery.

In 1906 the development of electricity as a motive power for textile mills became more generally established, and the Phœnix Works, being situated in the very centre of the heavy woollen industry, evolved many special appliances for textile work. There are to-day in Yorkshire and Lancashire innumerable firms which began business between the years 1906 and 1910, and have now become great and powerful organizations. Electricity can claim in many industries, but particularly in the textile trade, to have emancipated the small capitalist. If it had been necessary to purchase an engine, boiler, and the necessary power generating equipment, a great many of the younger men could not have procured sufficient capital to start a factory of their own. The growth of the Phœnix Works, coincident with that of the smaller type of textile factory in the Yorkshire district, is a significant illustration of the mutual benefit to engineering firms and manufacturers which may accrue from a cheap supply of electricity and a type of operating plant designed specially for any particular industry.

By virtue of their geographical position in



PHŒNIX WORKS, BRADFORD: SMALL AND MEDIUM MACHINE ERECTION DEPARTMENT.



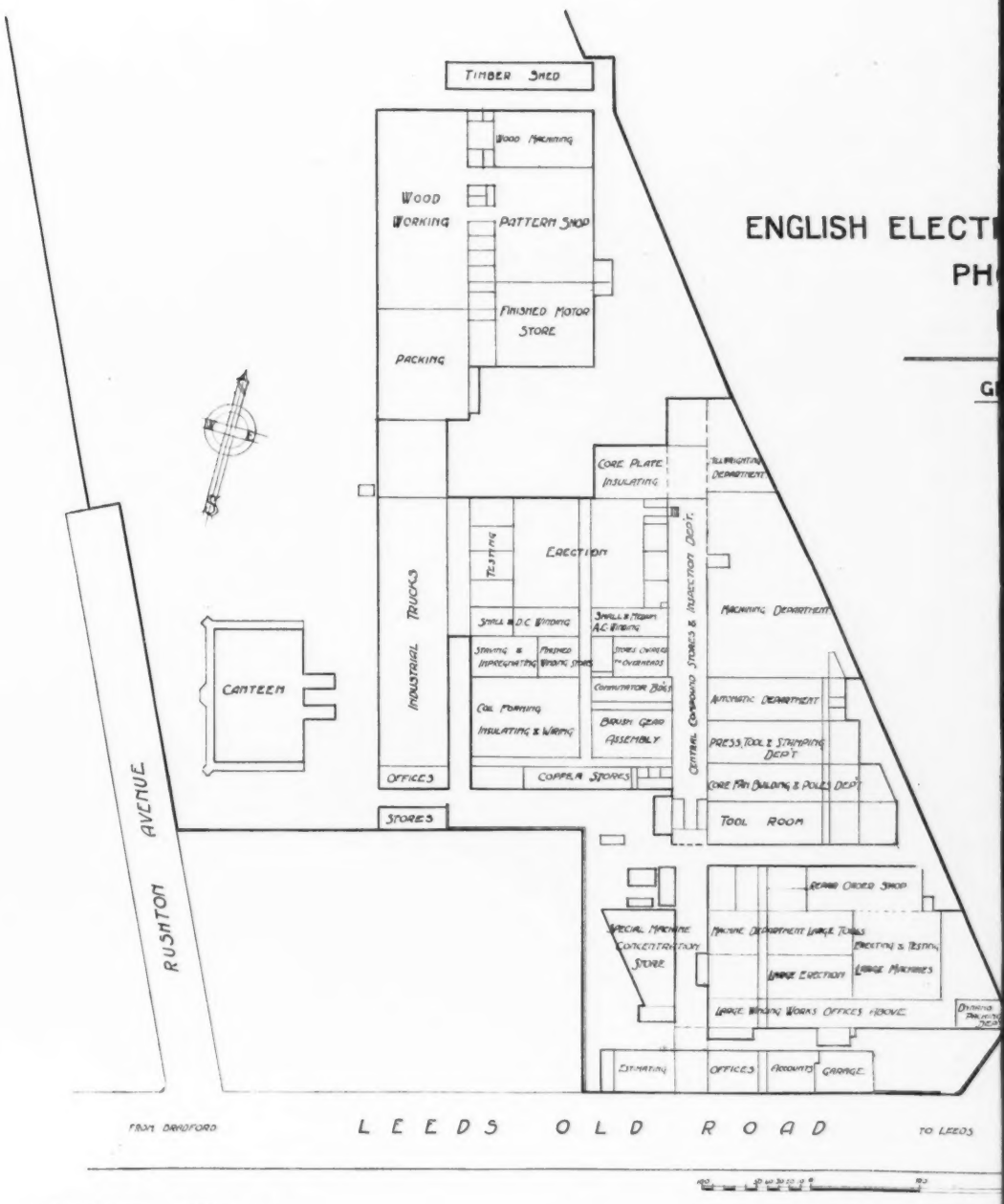
STAMPING DEPARTMENT.

AUTOMATIC MACHINE DEPARTMENT.

the Yorkshire coalfields, the Works almost automatically began to specialise on the application of electricity in coal mines. The inefficiency and cost of maintenance of compressed air machinery as a means for operating coal cutters and other portable machinery under ground, led to a very considerable increase in the use of electricity below ground and in fiery mines. This

Section of Winding Department.

necessitated an unusually close co-ordination between the manufacturer of motors for this purpose and the coal mining expert. One or two accidents, of which the cause was obscure, in the coal pits in which electricity was employed under ground, led to a real and not unnatural opposition on the part of the miner to this new form of power. The Phœnix Company appreciated that the whole subject was worth very special consideration, not only from the point of view of the theoretical efficacy of the explosion proof motor, but because it was essential to devise some form of test which would convince not only the coal owner but the miner himself that the safety of the machine upon which his life depended was without question. After many experiments the machine was designed and put upon the market, and an experimental explosion chamber was installed at the Works. Both the coal owners and the men's representatives were pressed to witness actual tests in an atmosphere similar to that of a fiery mine. It is claimed that, at any rate in the Yorkshire and Lancashire coalfields, this practical demonstration did much

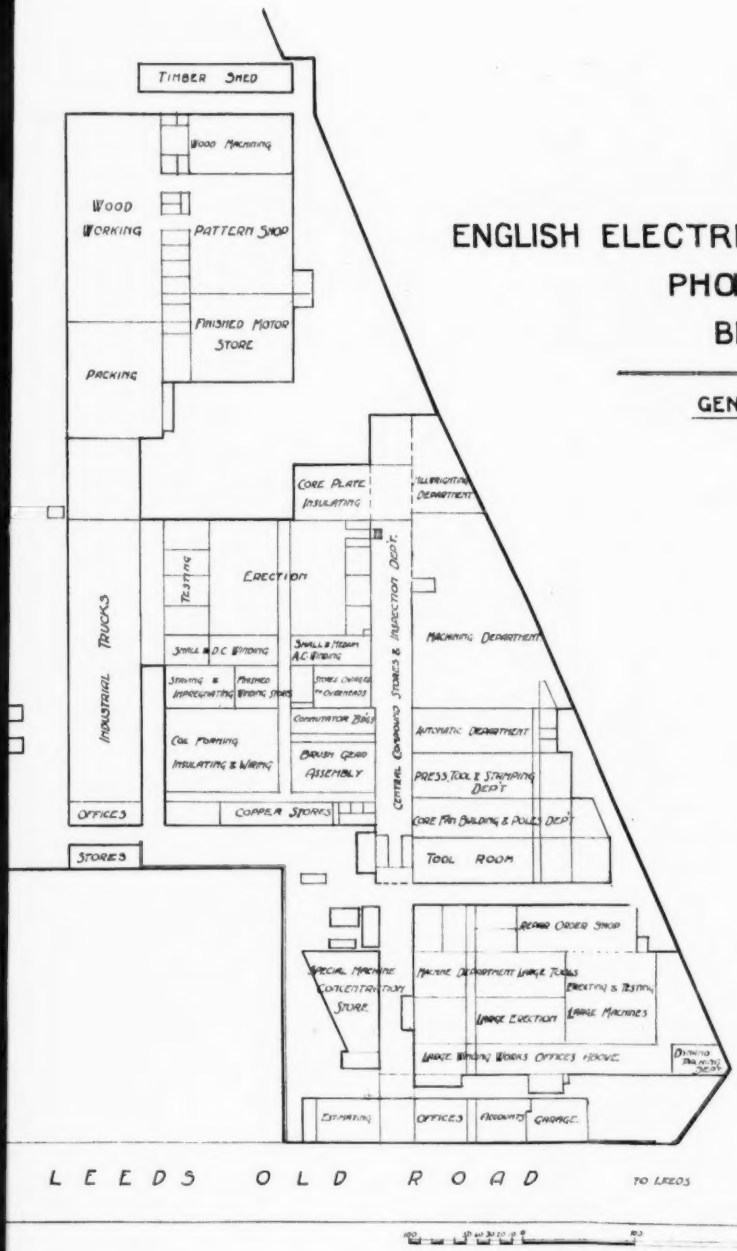


: THORNBURY WORKS :

SCALE

THE ENGLISH ELECTRIC COMPANY
PHŒNIX WORKS
BRADFORD

GENERAL PLAN



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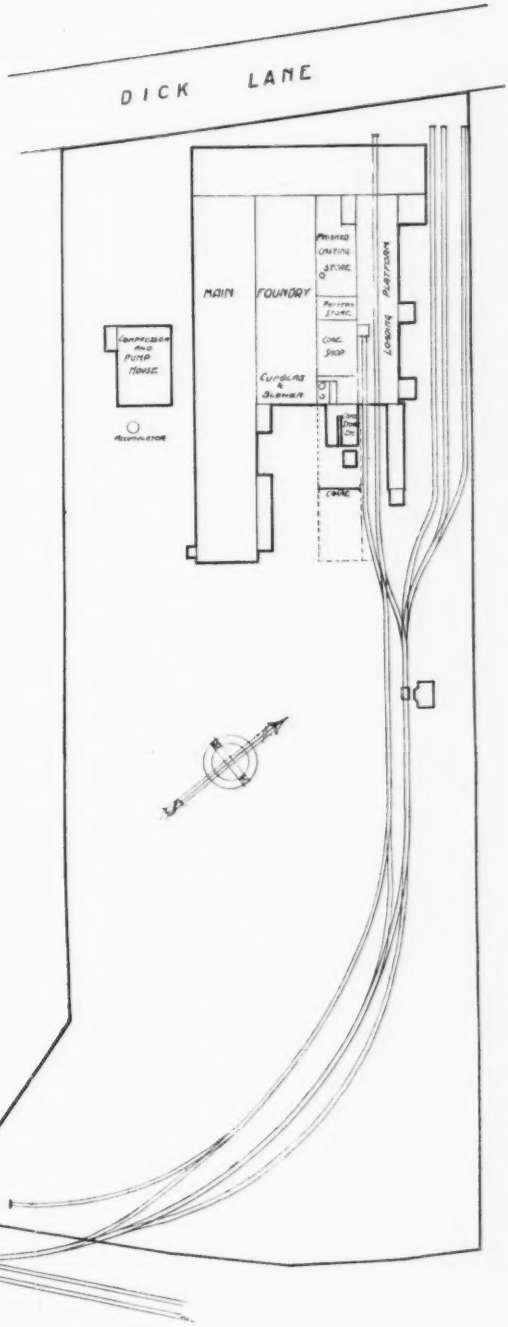


: DICK LANE WORKS :

LARGER MACHINE ERECTION DEPARTMENT.

SMALL AND MEDIUM MACHINING DEPARTMENT.

to remove the quite natural fears of the miner, and accelerate the more general application of electricity below ground. From this date onwards, every motor of this type has been tested in the manner just described, and the buyer has been invited to witness such tests. The type of machine was standardized at Bradford and secured a ready sale. The development of special impregnation and insulation for mining purposes, particularly in the use of open type motors for screens and other dusty positions, has resulted in a virtual elimination of the fully enclosed motor of large size from this class of work.

STANDARD MOTORS IN STORE.

TO-DAY.

One of the aims of the English Electric Company is to secure efficiency by dividing the manufacture of the Company's products into certain ranges of size and type, and manufacturing the total requirement of a particular article at one works. This principle has made it possible to remove from the Phœnix range all larger sizes of electrical machinery, thus occupying the factory solely on machines for which it was expressly laid out. It was on products of a repetitive character that the Works were employed before the war, and the cessation of hostilities left the factory and its plant well equipped for a larger and more intensified output of small standard electrical machinery. The general scheme of the lay-out will be obvious from the block plan printed with this article.

Goods are received and despatched at a rail-head running into the Great Northern main line, and having considerable siding accommodation. Here also is a foundry specially equipped for repetition work. Its capacity is such as to make it possible to manufacture the whole of the light repetition castings required by the entire group of works. It is equipped with automatic sand-handling devices and a number of moulding machines, and it is hoped, by the introduction of every known labour-saving device, to increase the foundry output of

CENTRAL STORES AND INSPECTION DEPARTMENT.

the group without a proportionate reduction in the capacity for larger and more complicated castings which can only be produced by the aid of highly-skilled moulders.

The manufacturing plant proper is at the original Thornbury Works, and the main scheme of the lay-out will be apparent from the plan accompanying this description. It will be noticed that a bay 600 ft. in length bisects the works. This is the Central Store, into which all materials are received and from which they are issued to the manufacturing departments and returned after completion for inspection and transfer to the assembly shops. The machining and detail sections of the works are on the right-hand side of the central bay and the assembly department on the left-hand side.

One effect of the very large amount of repetition work handled during the war has been to intensify the necessity for very extensive jigs of every known device for saving labour: the contraction of the range of products manufactured at Bradford has further intensified the possibilities of increased efficiency in this direction, and whilst the expression "mass production" has become, since the war, a misnomer in British engineering, every effort is being made to secure to the highest possible degree the efficiency resulting from a reduction in the number of standards. No attempt is being made to force upon the purchasers in this country and abroad a higher degree of standardization than the immense variety of the applications of industrial electrical machinery will allow. It should not, however, be overlooked that whilst there does not appear to be any parallel between the complete standardization enforced in the production of a Ford motor car and an electrical machine, every modification from a reasonable standardization enforced by the buying public results directly in an increased cost of, and a proportionate restriction in, the general application of electricity to industrial purposes.

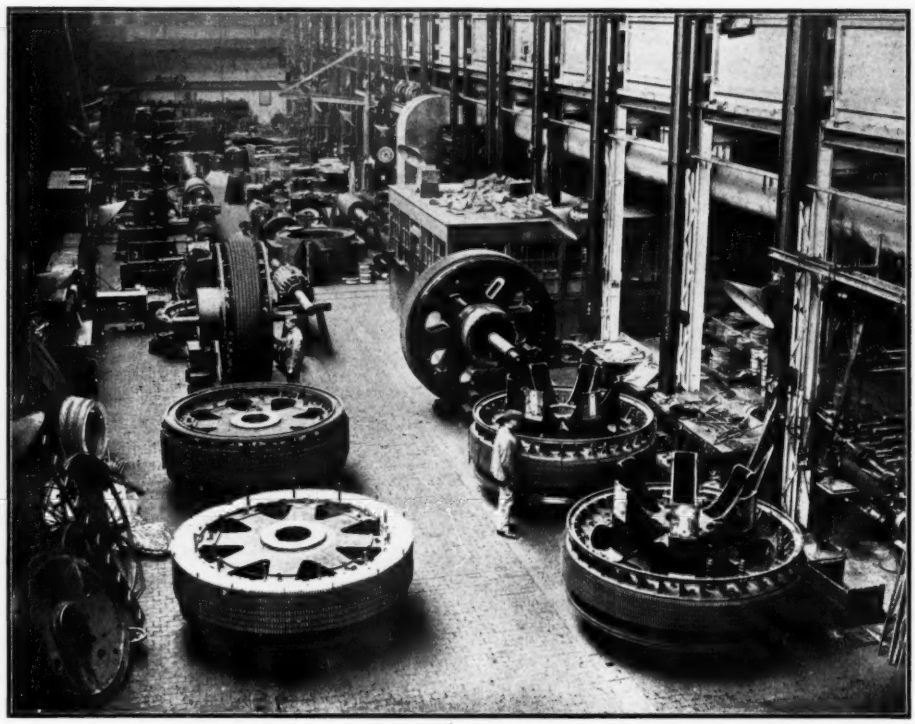
The Automatic Department is equipped with full automatic turning machines for dealing with the bar and chucking demands of the electric motor business. Steel is very largely used for the frames of direct-current motors, the resultant lightness being considered of great importance in view of the increased cost of transport for foreign work.

Increase in the application of electricity to textile factories renders the favourable geographical position of the Bradford Works to the textile industry in general a very great factor in the type of work there undertaken. The amalgamation of the joint experience of the associated firms, placing the company, as it does, in a position to supply the complete mill equipment, generating plant as well as motors, has already resulted in a large number of such complete schemes being carried out by the Company.

Adjacent to the works is the Phœnix Park, a sports and recreation club for the use of the employees of the Works and their families. The park, which was formerly a farm, covers 70 acres, and now includes cricket and football grounds, bowling greens and a nine-hole golf links. The converted farmhouse and buildings are used for social purposes. The club is managed by the men themselves through the Phœnix Park Association, the capital of which was entirely subscribed by them.

The Siemens Works, Stafford.

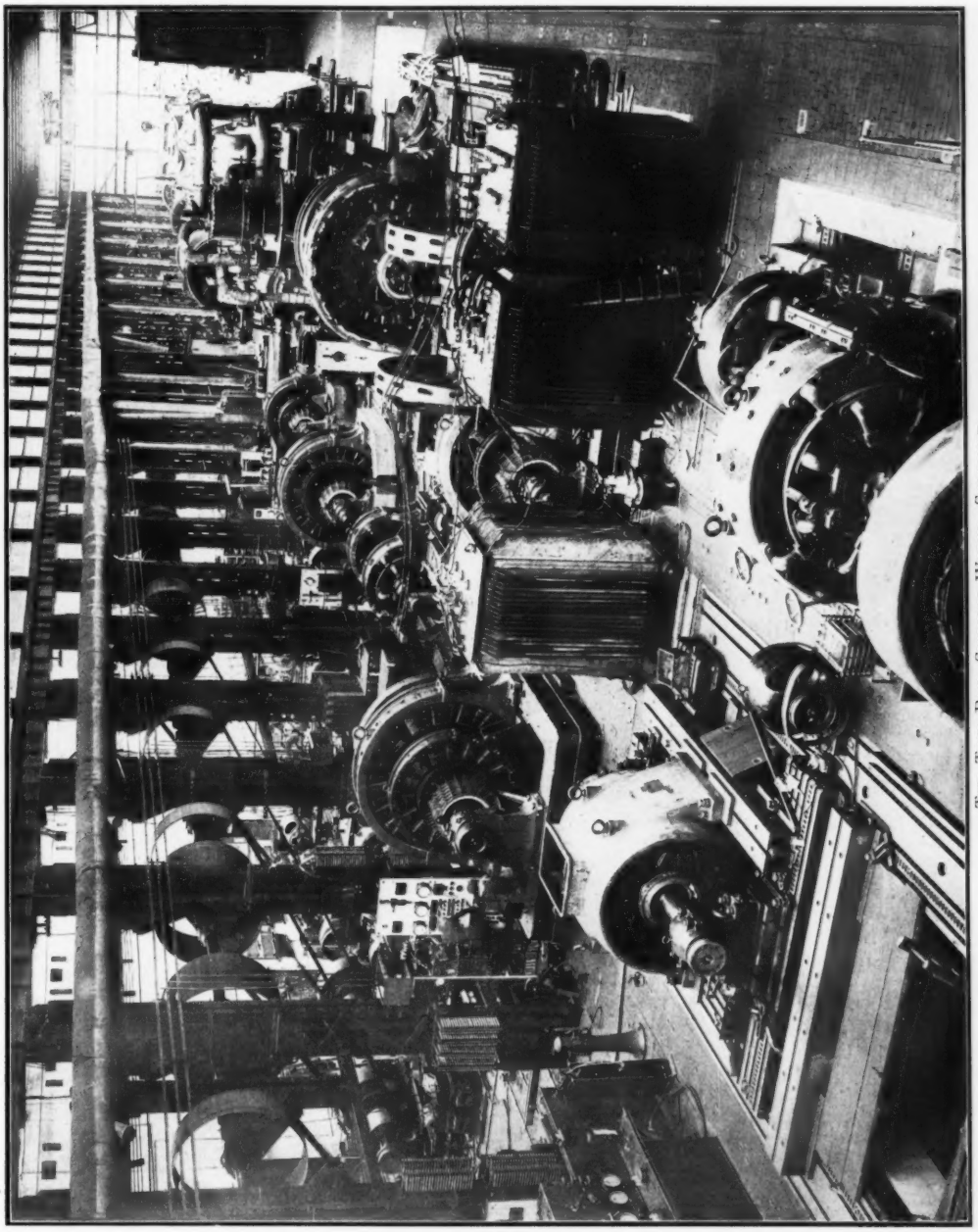
(October, 1920).



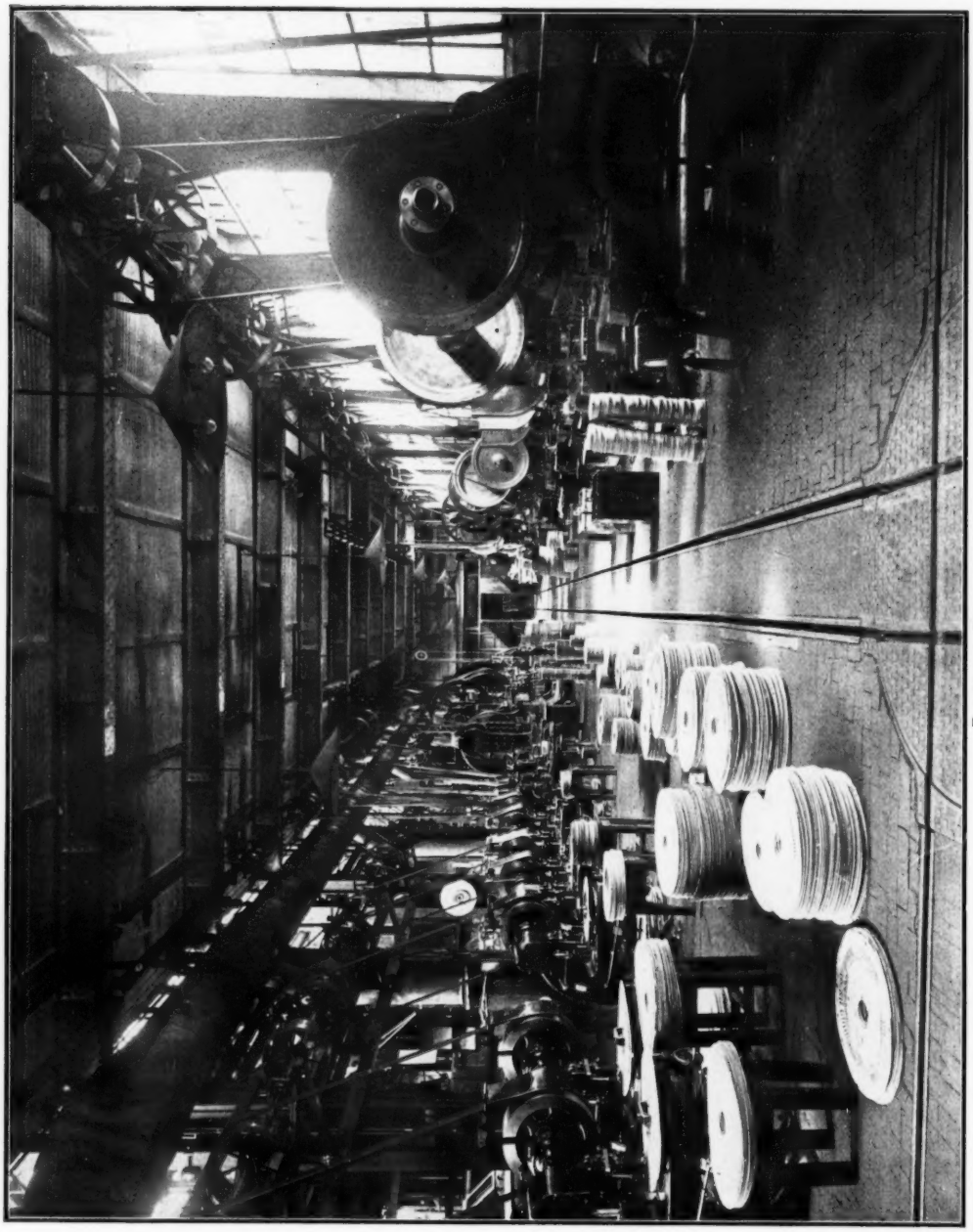
CORE BUILDING SHOP.

THE ORIGIN AND LAY-OUT OF THE WORKS.

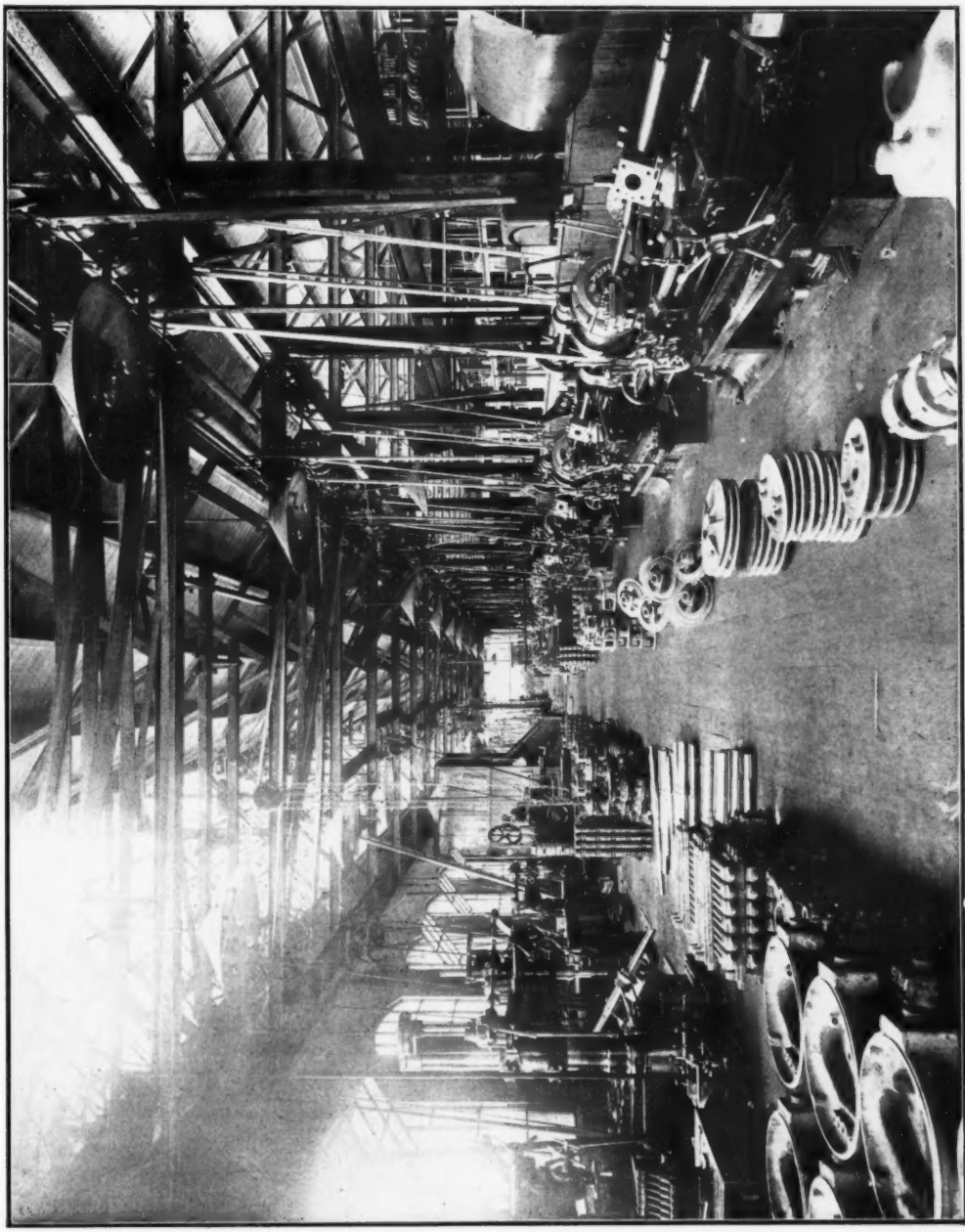
The Siemens Works, Stafford, which were erected in 1903, were acquired by the English Electric Company in 1919 by purchase from Siemens Bros. Dynamo Works, Ltd. Stafford was originally selected by the latter firm, after full consideration of alternative sites in other parts of the country, as the most suitable town for the establishment of a works for the manufacture of general electrical machinery; and the estate which was bought was laid out in such a way as to provide, in addition to a modern works, recreation grounds and cottages for employes. The town is situated in a country district midway between the Potteries and the



THE TEST BAY, SIEMENS WORKS, STAFFORD.



PUNCHING DEPARTMENT.



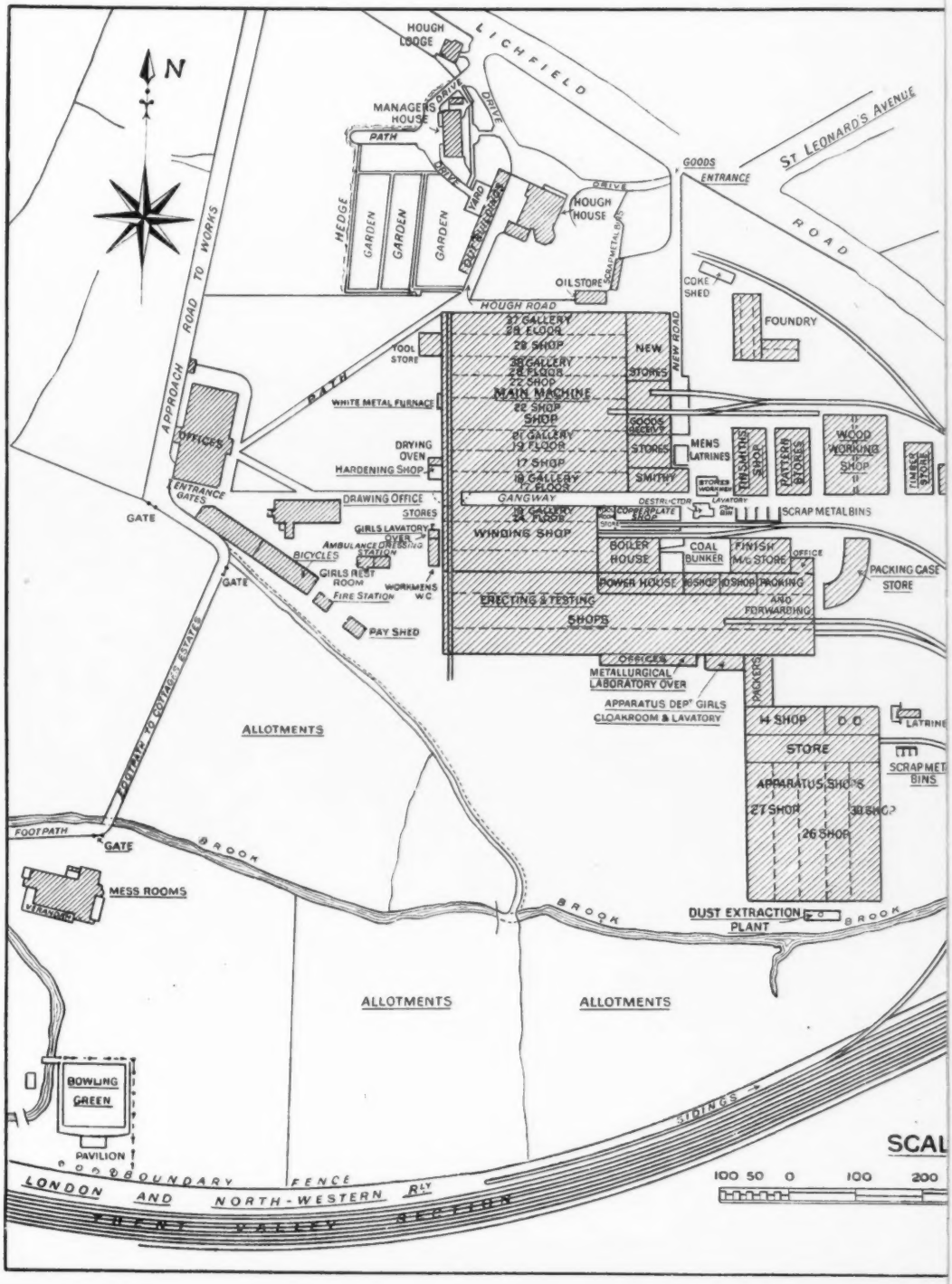
SMALL MACHINE SHOP.

Black Country, on the London and North Western Railway main line, with excellent railway communication to all parts of the country

The works property is about 56 acres in extent, of which 5½ acres are under roof, with a total floor space of 275,000 square feet.

Even a casual inspection of the works gives ample evidence of the exceptionally favourable conditions in which they were erected. They were built by an electrical engineering firm which had long experience in the manufacture of electrical plant and was able to select an ideal site and there put up a factory on the most modern lines. The buildings are well lighted, and are equipped with an efficient ventilation and heating system. As will be seen from the plan printed with this article, the works consist of two main portions—one for the production of electrical machinery and the other for the manufacture of switchgear and apparatus. There are good general purpose shops and a small foundry, and the works have their own power-house for the generation of electricity for lighting, power and test requirements. Ample accommodation is provided for general offices and for the technical staff and drawing offices. The several shops are extremely well served with railway sidings and internal tracks, and throughout the lay-out the scientific routing of material has been considered, ample space

Erecting Shop.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MANAGER'S HOUSE
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YARD
HOUGH HOUSE
GOODS ENTRANCE
OIL STORE
COKE SHED
FOUNDRY
HOUGH ROAD
NEW ROAD
APPROACH ROAD TO WORKS
PATH
TOOL STORE
WHITE METAL FURNACE
OFFICES
ENTRANCE GATES
GATE
DRYING OVEN
HARDENING SHOP
DRAWING OFFICE
STORES
GIRLS LAVATORY OVER
AMBULANCE DRESSING STATION
BICYCLES
GIRLS REST ROOM
FIRE STATION
WORKMENS W.C.
PAY SHED
GATE
37 GALLERY
28 FLOOR
28 SHOP
35 GALLERY
26 FLOOR
22 SHOP
MAIN MACHINE
22 SHOP
SHOP
21 GALLERY
12 FLOOR
17 SHOP
19 GALLERY
17 FLOOR
GANGWAY
15 GALLERY
14 FLOOR
WINDING SHOP
NEW STORES
GOODS INWARDS
STORES
SMITHY
MENS LATRINES
TINSMITHS SHOP
PATTERN BLOCKS
WOOD WORKING SHOP
TIMBER STORE
DESTRUCTOR
LAVATORY
SCRAP METAL BINS
BOILER HOUSE
COAL BUNKER
FINISH M/C STORE
OFFICE
PACKING CASE STORE
POWER HOUSE
6 SHOP
10 SHOP
ERECTING & TESTING SHOPS
PACKING AND FORWARDING
OFFICES
METALLURGICAL LABORATORY OVER
APPARATUS DEPT GIRLS CLOAKROOM & LAVATORY
PACKERS
14 SHOP
D.O
LATRINE
STORE
SCRAP METAL BINS
APPARATUS SHOPS
27 SHOP
30 SHOP
26 SHOP
DUST EXTRACTION PLANT
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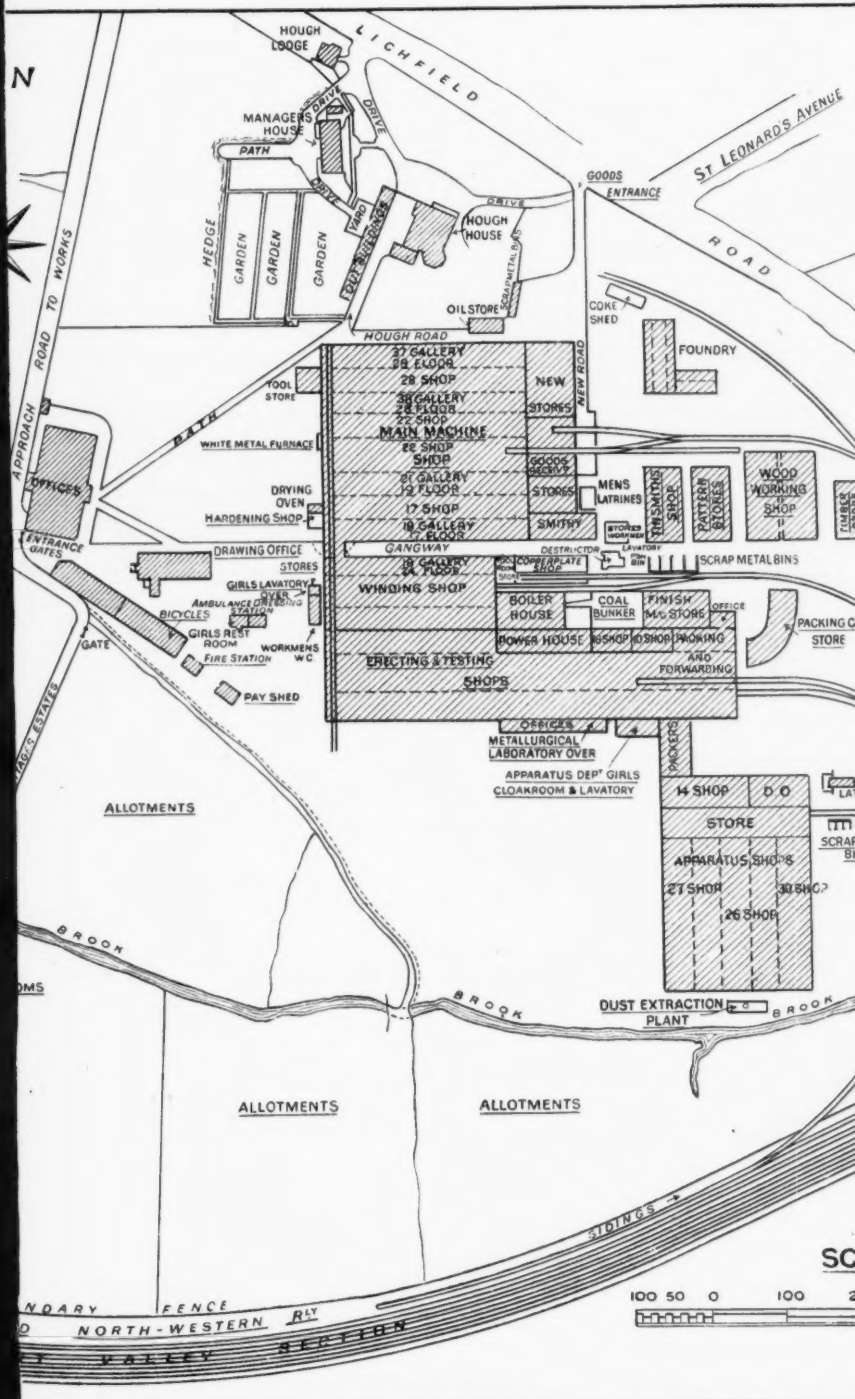
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38 GALLERY
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MAIN MACHINE
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12 FLOOR
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WOOD WORKING SHOP
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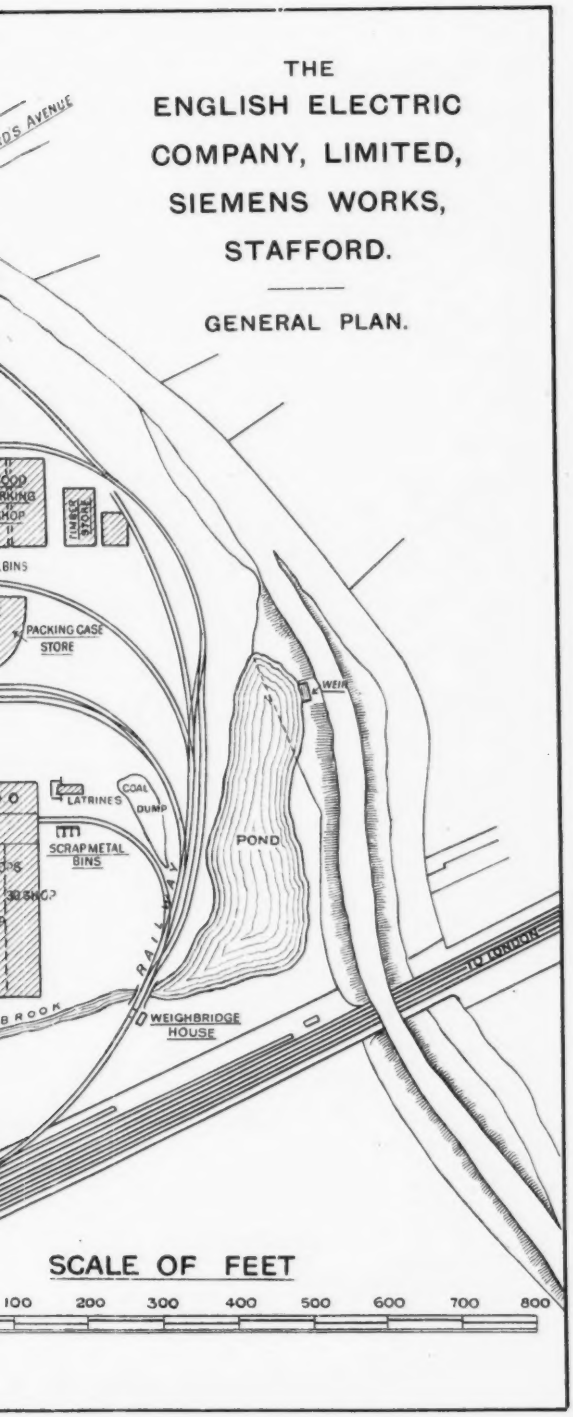
THE
ENGLISH ELECTRIC
COMPANY, LIMITED,
SIEMENS WORKS,
STAFFORD.
GENERAL PLAN.
PACKING CASE STORE
WEIR
LATRINES
COAL DUMP
SCRAP METAL BINS
POND
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WEIGHBRIDGE HOUSE
SCALE OF FEET
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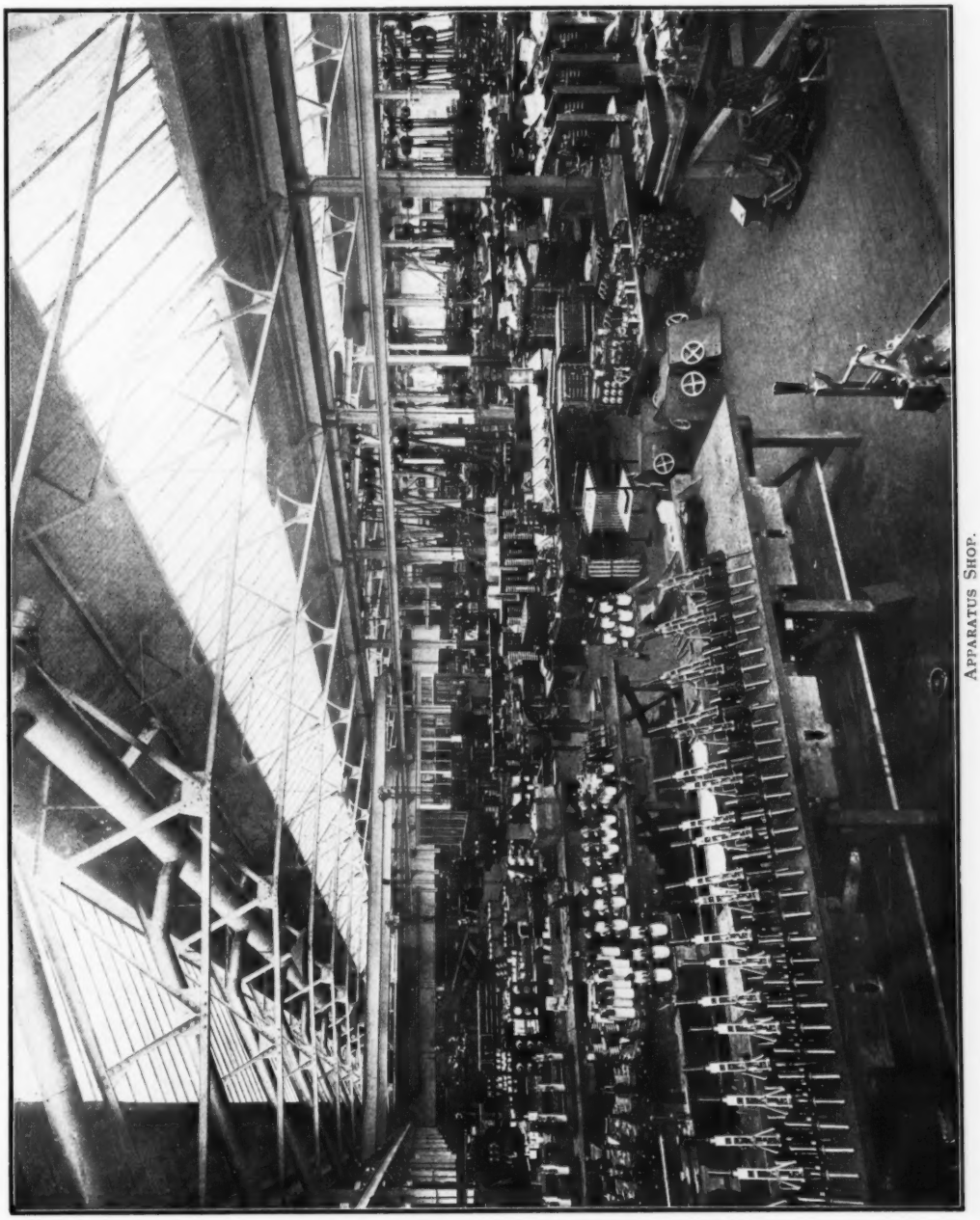
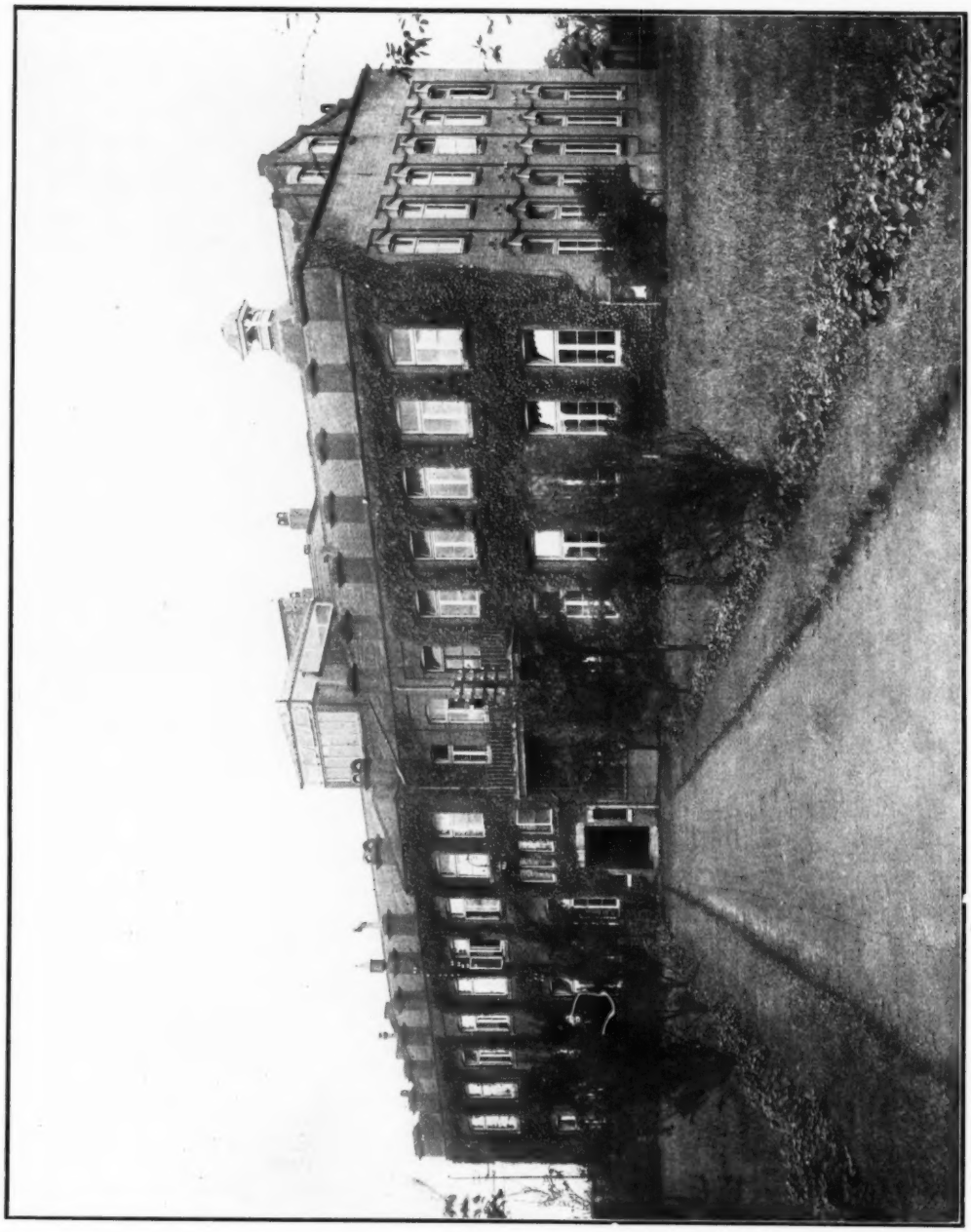


APPARATUS SHOP.



OFFICE BUILDINGS.

Core Building Shop.

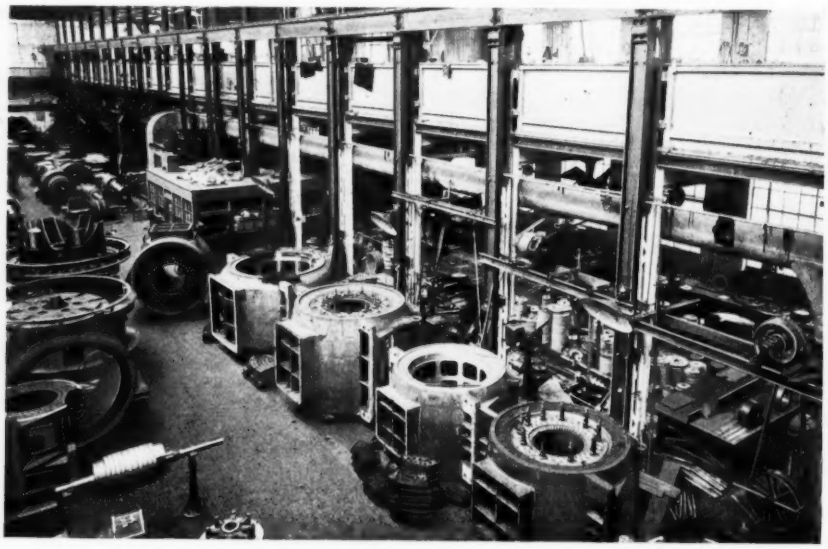
having been provided for stores for raw materials, finished parts and finished machines. It thus becomes possible for material to be brought in, moved through the works during the processes of manufacture by a continuous progression, and ultimately despatched with the minimum of handling.

It will be seen from the plan that a mess-room is provided on the estate near the works. Beyond this are the sports ground, the bowling green, and the allotments near the London and North Western main line. All these are managed by committees of men employed at the works in the interests of the employes as a whole.

The Future of Stafford Works.

Since Siemens Brothers Dynamo Works, Ltd., had no other works for the manufacture of electrical machinery, they undertook at Stafford the manufacture of a wide range of machines. At the same time, the size of the larger types of electrical plant has gradually increased since the Stafford Works were built. For these reasons, the works came to be making not only a large variety of types of plant, but units both smaller and larger than those for which Stafford was originally designed.

Since their acquisition of the Stafford Works the English Electric Company have been able to arrange for the manufacture of the extremes



CORE BUILDING SHOP.

of the Stafford range to be transferred to other factories. The Ordnance Works, Coventry, are undertaking in their light shops the manufacture of the smallest types, such as loom and fractional horse-power motors, and will build very large machines in their heavy shops. The Phœnix Works, Bradford, concentrate on the production of small machines. Moreover, since the accommodation at Stafford for the manufacture of Static Transformers has been found inadequate, larger shops devoted to this type of plant have been provided at Coventry. In this way it becomes possible to devote the whole capacity of the Stafford Works (apart from the Apparatus Shops) to the construction of the medium electrical machinery, for which they are particularly suited.

This process of redistribution between the different works of the Company of the types of plant to be manufactured is one of the chief improvements in methods of production which the formation of the English Electric Company made possible. It is necessarily a gradual process, which must be carried out in such a way as not to disturb the execution of existing contracts and to ensure continuity of production The experience of each works in the group is drawn on in the development of the most modern designs for every type of plant—designs which can be adopted as English Electric standards. In the elaboration of such standards the designing and manufacturing experience of the Stafford Works over the whole range which they touched is of the greatest value.

The Willans Works, Rugby.

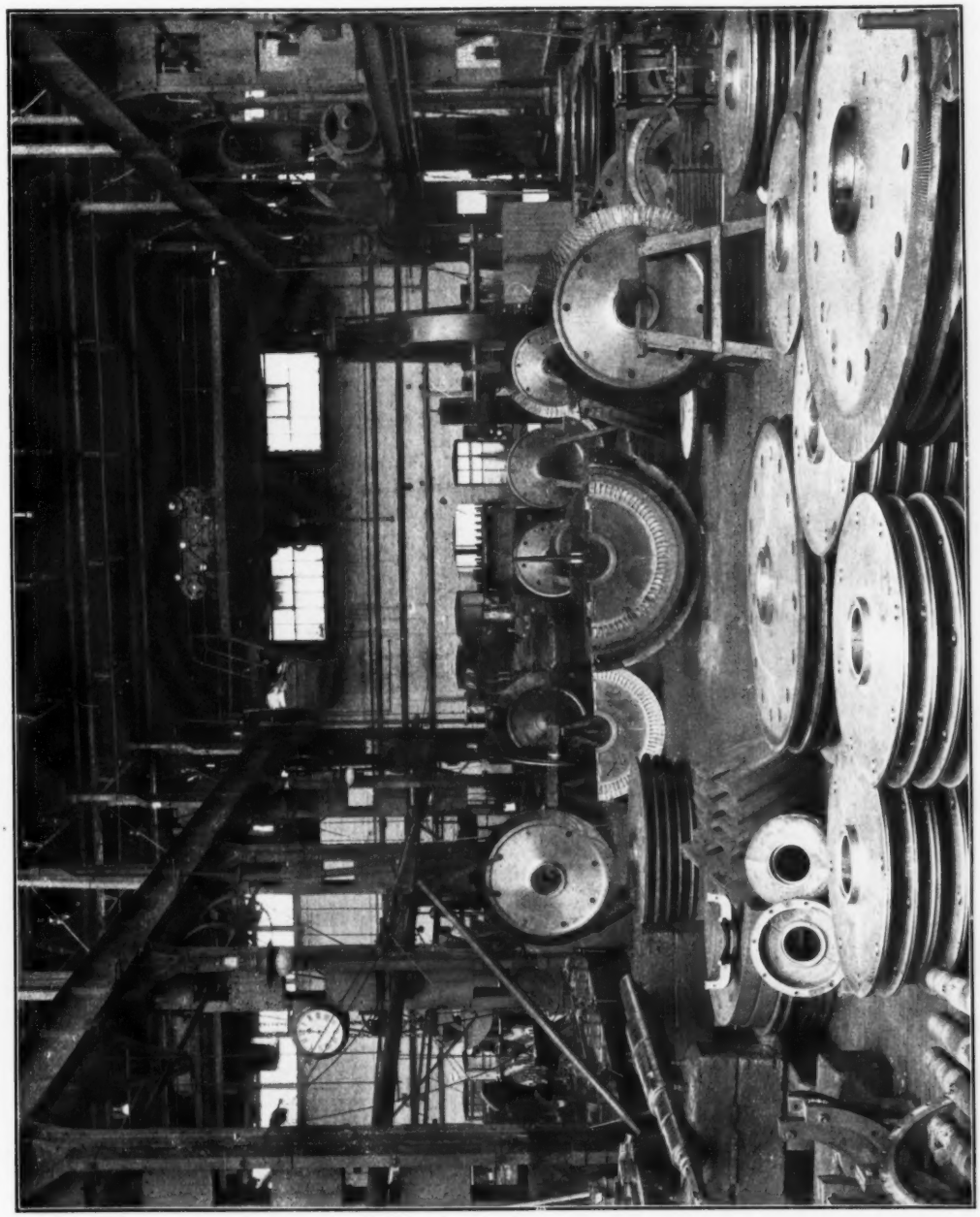
January, 1921.

No. 19 Bay, Heavy Iron Foundry.

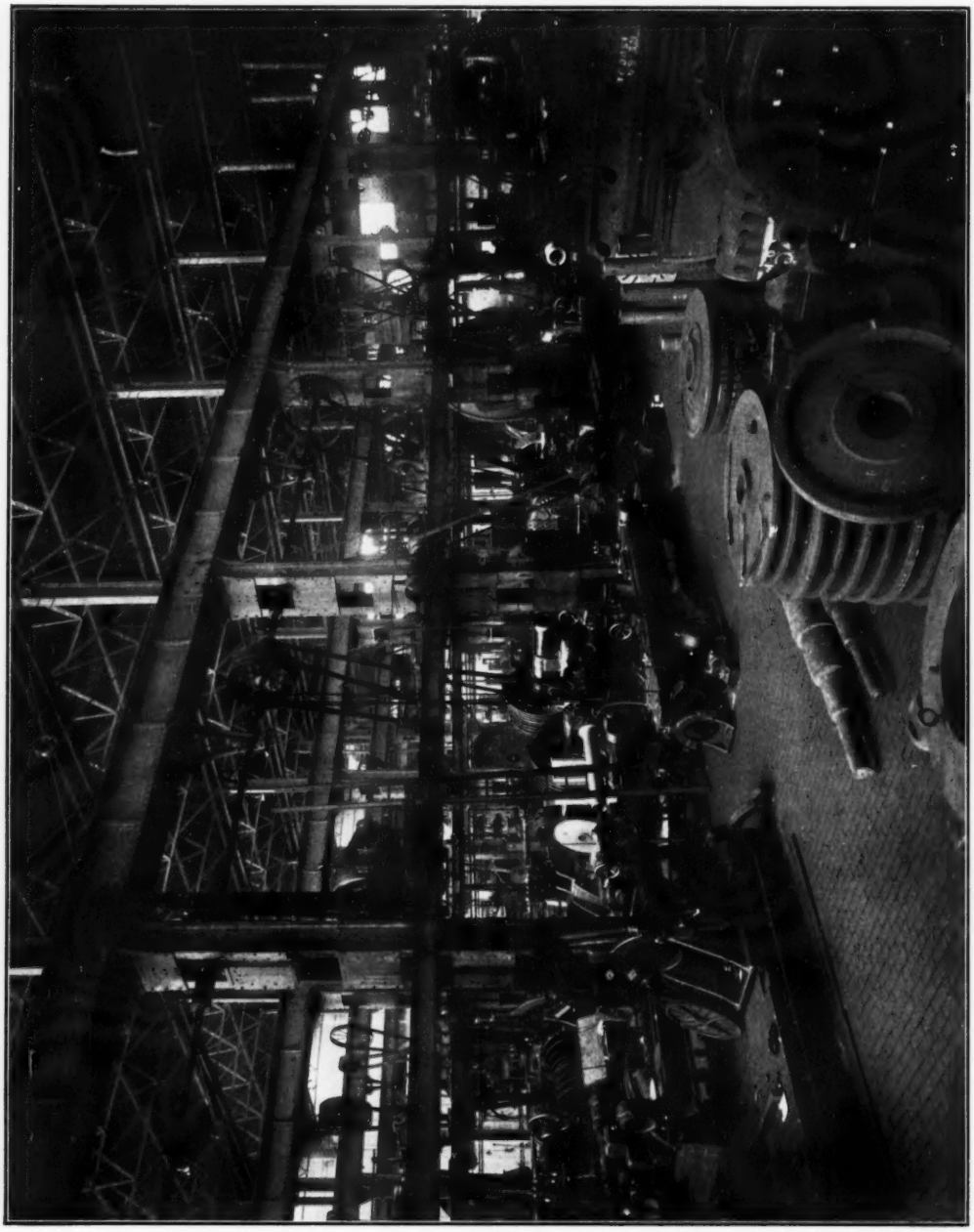
The Rugby Works of the English Electric Company stand upon a site forty-one acres in extent adjoining the London and North Western Railway, the property having a frontage on the line of over half a mile. The old company (Messrs. Willans & Robinson, Limited), who transferred their business here from Thames Ditton in 1897, originated about forty years ago in a partnership between the late Mr. P. W. Willans and Mr. Mark Robinson. In 1888 the concern became a private Limited Company, and was later re-constituted as a Public Company in 1893.

The speciality with which the business was

General View of Willans Works, Rugby.



TURBINE BLADING SHOP.



View in the Machine Shop.

originally concerned in the partnership days was a small high speed Marine Steam Engine, with the manufacture of which was combined that of steam launches and boilers in a small riverside shop on the Thames at Thames Ditton, near Hampton Court. This was the first high-speed engine which was really successful as regards

culminated, in 1884, in the development of the central valve engine in the form in which it became so well known and met with so great a measure of success during the succeeding twenty years. It remained during that period the chief product of the Company's Works

Pattern Shop, Pattern and Timber Stores.

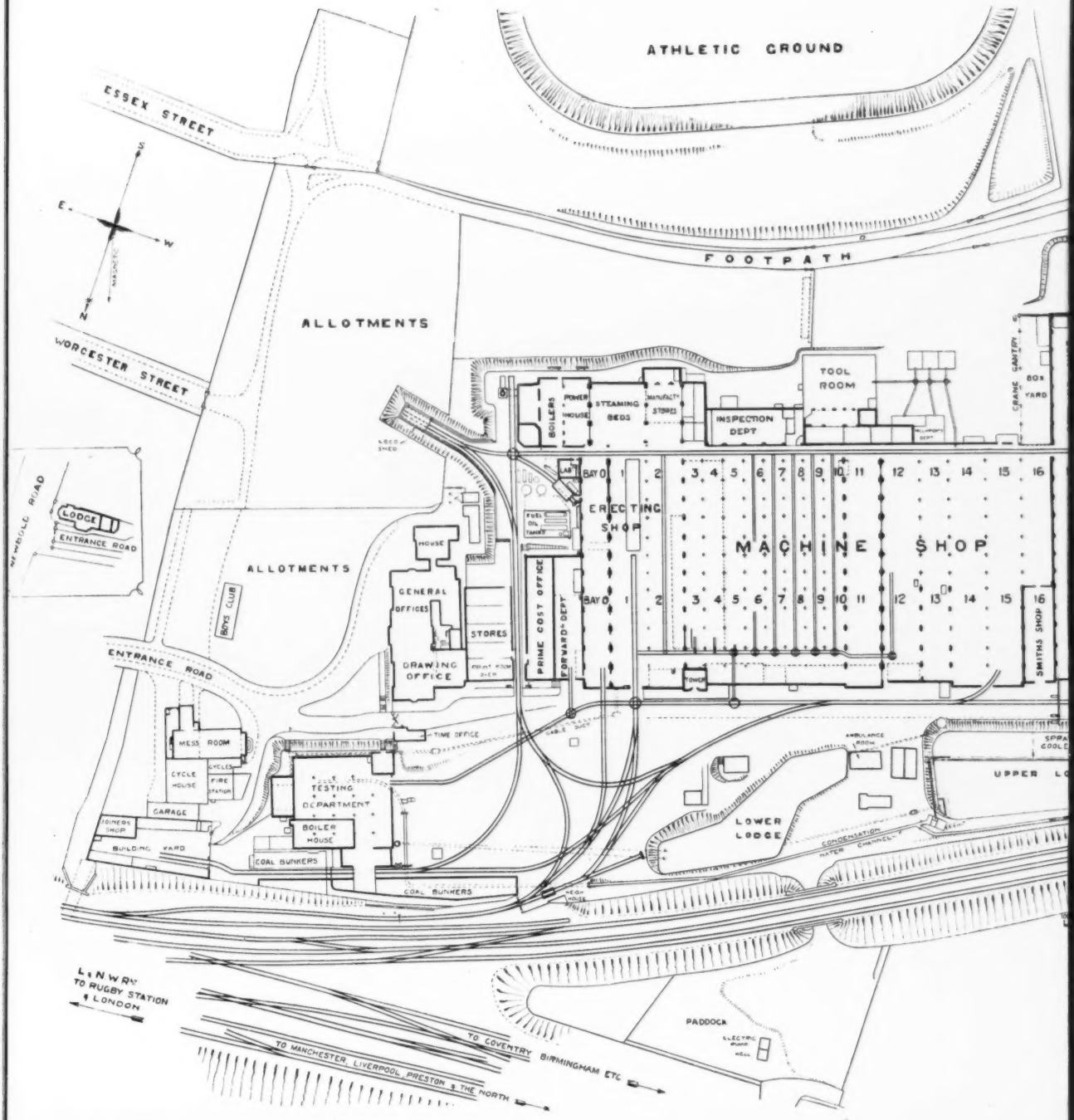
both durability and steam economy, and due to this fact, and to the advent of electric lighting in this country, the suitability of the engine for the direct driving of dynamos was very soon recognised. To render it better fitted for this purpose, however, important additions and improvements were made by Mr. Willans, which

It was the need of room for growth and of better railway facilities that made removal from Thames Ditton imperative. This removal also permitted the laying down and equipment of a completely new factory with every modern improvement; and full advantage was taken of the opportunity so presented.

Not long after the removal to Rugby a demand for steam units of larger sizes than those previously manufactured became steadily more urgent The difficulty of the problems in the design of reciprocating engines to which this demand led gave impetus to the development for land purposes of steam turbines, which had by that time been tried with complete success for marine propulsion. In consequence of this trend of affairs, the Company undertook the manufacture of steam turbines in 1903, and this new development, which met with immediate success, laid the foundations for the extensive manufacture of this type of machine ever since carried on at Rugby.

One of the main features that contributed to the success of the central valve engine, as also to that of the turbines turned out by the Company, was the excellence of the castings; and it was only natural that with the advent of turbine work, attention should have been given to the manufacture of Condensers and Air Pumps, which form so important a part of all turbine installations Similarly, the rapid development of the automobile industry, particularly in the Midlands, created a demand for small high-grade iron castings, and from 1904 onwards this business was developed extensively at Rugby. At about that time, too, the Diesel Engine was beginning to make headway

PATTERN SHOP.


ATHLETIC GROUND
ESSEX STREET
FOOTPATH
ALLOTMENTS
WORCESTER STREET
ALLOTMENTS
LODGE
ENTRANCE ROAD
BOYS CLUB
ENTRANCE ROAD
TOOL ROOM
INSPECTION DEPT
BOILERS
POWER HOUSE
STEAMING BEDS
ERECTING SHOP
MACHINE SHOP
BAY 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
PRIME COST OFFICE
FORWARD DEPT
GENERAL OFFICES
STORES
DRAWING OFFICE
SMITHS SHOP
TIME OFFICE
MESS ROOM
CYCLE HOUSE
FIRE STATION
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BUILDING YARD
TESTING DEPARTMENT
BOILER HOUSE
COAL BUNKERS
COAL BUNKERS
LOWER LODGE
UPPER LODGE
CONDENSATION WATER CHANNEL
PADDOCK
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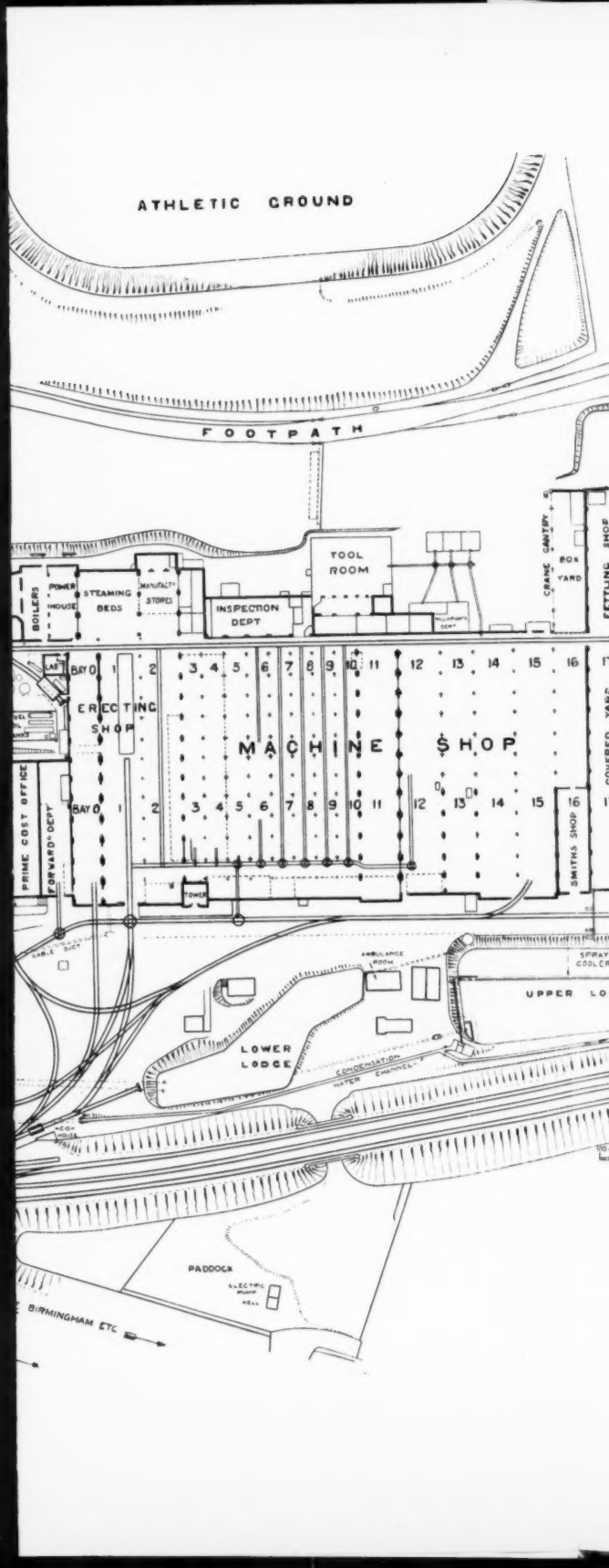
TO RUGBY STATION
LONDON
TO COVENTRY BIRMINGHAM ETC
TO MANCHESTER, LIVERPOOL, PRESTON & THE NORTH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ERECTING SHOP
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TOWER
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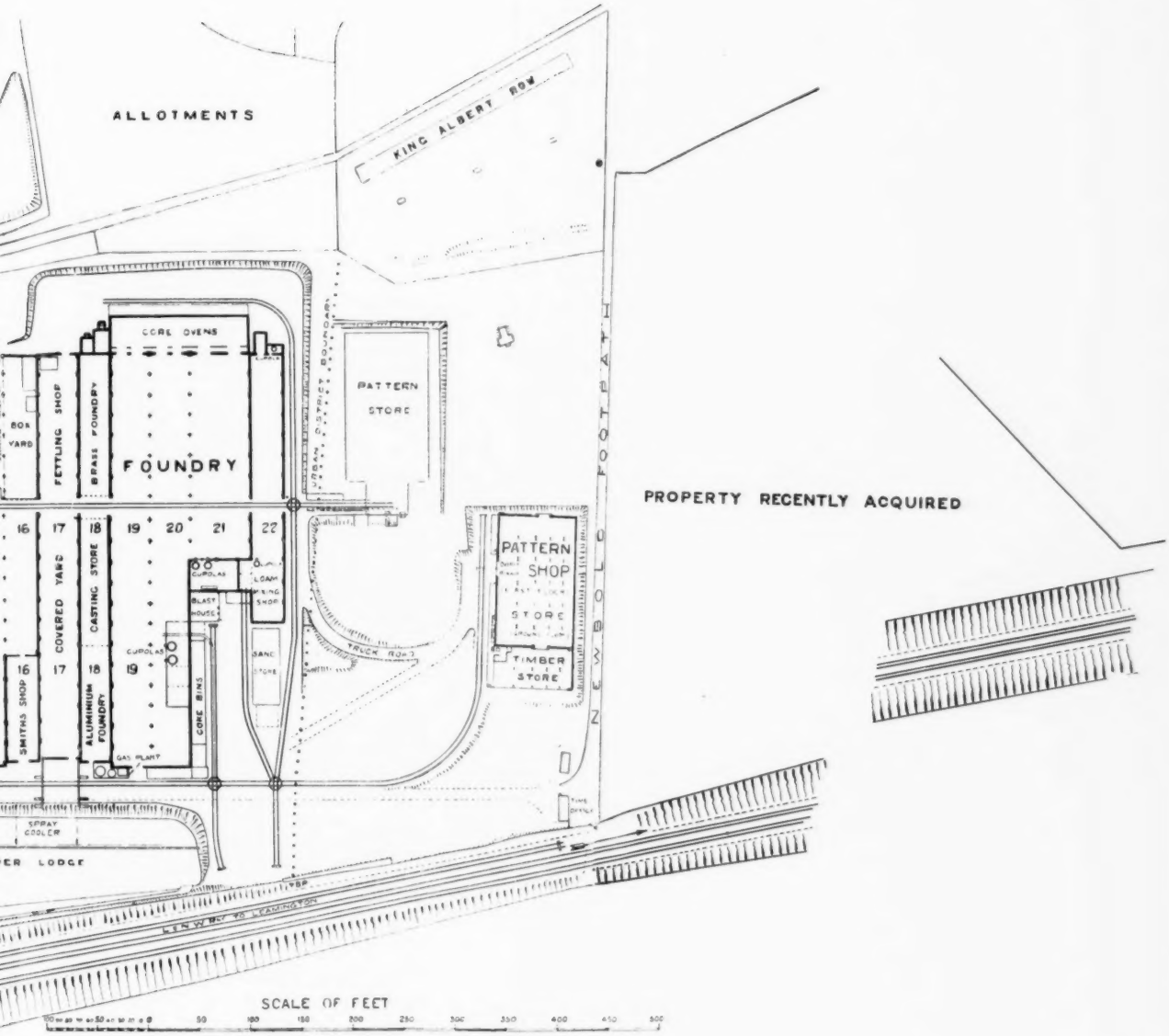
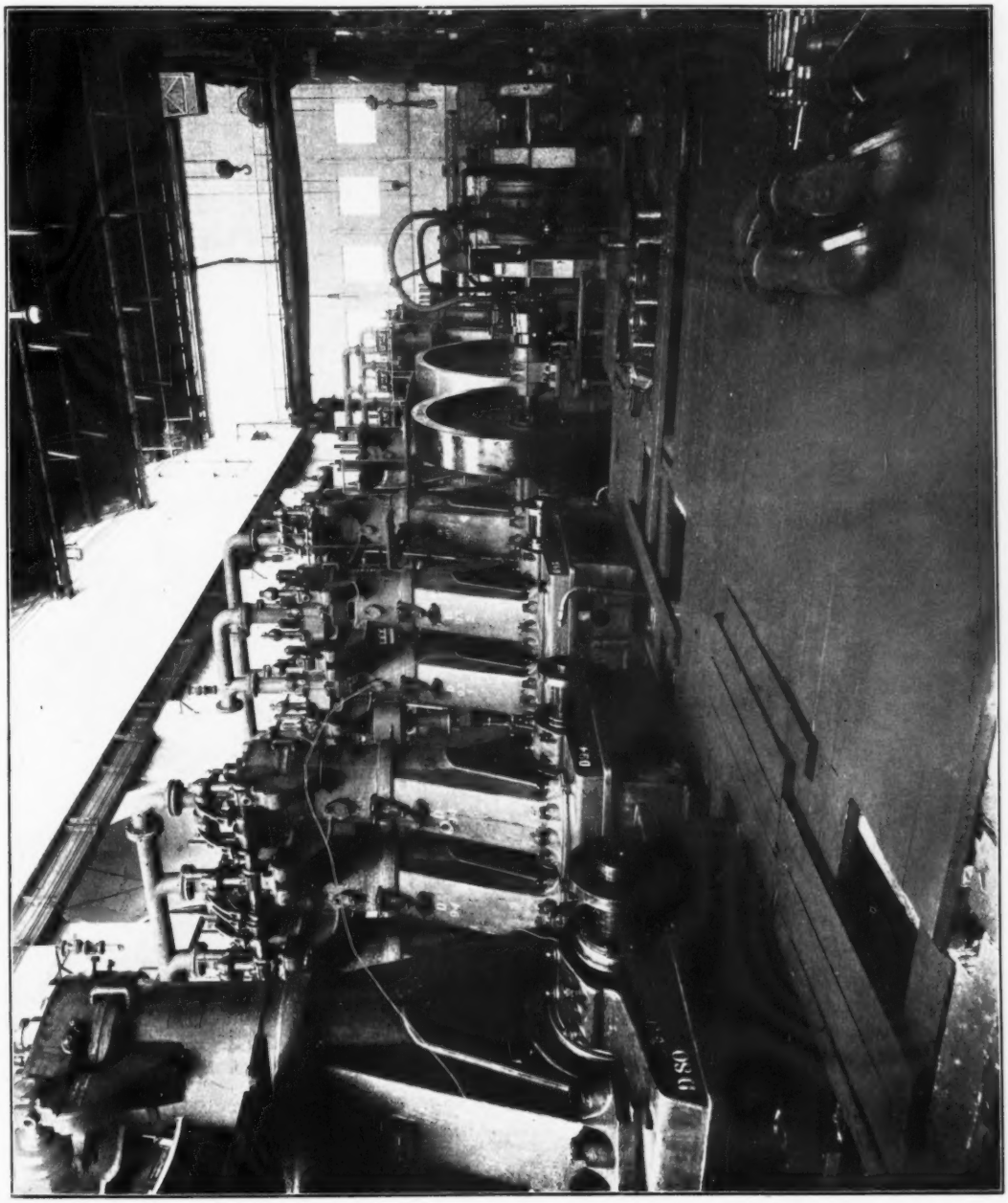
LOWER LODGE
CONDENSATION WATER CHANNEL
PADDOCK
BIRMINGHAM ETC



THE
ENGLISH ELECTRIC COMPANY LIMITED
WILLANS WORKS
RUGBY
GENERAL PLAN



DIESEL ENGINE TEST BED.

on the Continent, and the fact that the Rugby Works had always been associated with work requiring a high degree of accuracy, and manufactured on such a basis as to be interchangeable, rendered the Diesel Engine a very suitable product for works which had also been laid down primarily to deal with a high-grade type of Reciprocating Engine. From that time until the present day the production of Diesel Engines has been carried on as one of the main lines of manufacture concurrently with turbines and condenser plants.

Office Buildings.

The works buildings have been extended and improved from time to time for increases in the volume and changes in the character of the work undertaken. These extensions have been carried out in conformity with the original plans, in which, from the outset, provision was made for systematic development as occasion might require in the future. From the first, also, the questions of railway siding accommodation, loading, storage, and the orderly progression of material from stage to stage have been very carefully kept in view. The result is that the works buildings to-day, which have been nearly trebled in area since first established, and cover about seven acres under roof, are in every respect conveniently disposed for economical handling of the products and present the same compact and symmetrical appearance as in the original project.

As will be seen from the plan, the front of the works buildings faces north, nearly parallel with the railway, between which and the shops is an open space tapering from 200 to 100 feet wide. A line of rails runs outside the full length

of the works, and between these and the railway are two "lodges," or ponds, used for water supply and cooling purposes.

This main block of buildings, comprising the Machine and Erecting Shops, is constructed in bays running north and south, divided in some cases by brick piers and arches, but generally by lattice steel stanchions which carry the traveller girders. At a higher level the stanchions carry cross girders running east and west. These support rolled steel gutters and light principals, the latter carrying the "weaving shop" type of roof, the ridges and gutters of which run east and west; the light is from the north.

At the west end of the main block is the foundry, with a total floor area of 58,700 sq. ft., of which 11,700 sq. ft. are devoted to brass founding. To the west of the foundry, and completely detached, are the Pattern Shop and Pattern Stores, with a total area of 22,000 sq. ft.

All the shops are well lighted and ventilated and are provided with efficient modern machine tool equipment. Included in the tools most recently installed are a heavy internal grinding machine suitable for dealing with large internal combustion engine cylinders, and a heavy crank grinder; both these machines are amongst the largest of their type in use in this country. There is also a well-equipped Chemical and Metallurgical Laboratory, which is situated at the south-east corner of the Works block, close to the Power House. Current is generated in the Power House for Works lighting and power purposes by Diesel Engine driven sets. A battery of Water Tube Steam Boilers also adjoins the Power House for supplying steam for turbine testing.

The Office buildings, in which are accommodated the Technical, Drawing Office and other staffs, are at the eastern end of the Works, and are approached by a private road. Adjoining the open space in front of these buildings are the Testing Department block and a brick-built Mess Room for the use of the employees; also the Works Fire Station.

We have shown in previous articles how the English Electric Company has taken advantage of the combination of several Works under one control to re-distribute the ranges of electrical manufactures in such a way as to make the most efficient use of the facilities available in each Works. The same principles have been followed in regard to the general engineering or mechanical products with which the Rugby Works have been so far exclusively concerned. The dimensions and equipment of the larger shops at the Ordnance Works, Coventry, render them especially suitable for the heavier class of turbine work. The present tendency in the matter of prime-movers is in the direction of larger units for the generation of power in municipal and other supply stations. This has involved the development of turbines and auxiliary plant heavier than the Rugby Works can most conveniently undertake, whereas those Works are particularly well laid out for dealing with High-Speed Turbines of the lower ranges of output. It is intended, therefore, to manufacture there turbines of all sizes up to about 5,000 K.W. capacity, Coventry Works taking over the upper ranges.

The manufacture of Internal Combustion Engines of Diesel and other types is to be concentrated at Rugby, where the shops are, as already indicated, exceptionally well adapted for such work. The large Iron Foundry, with a capacity much in excess of that required to supply the wants of the Rugby Works themselves, will be used to the fullest extent in helping to fill the requirements of the other Works in the way of castings.

The large open plot of land at the south side of the Works is laid out as an Athletic Ground, which covers seven acres, and is devoted entirely to the Willans Works Athletic Club, membership of which is confined to the employees of the Company. There is also a Works Provident Society, which is approved under the Government Scheme for administration of the National Insurance Acts for the benefit of the employees who are members of it.

It is interesting at this time to recall that the principle of "Payment by Results" (Premium Bonus) has been operative in the Works for nearly thirty years, the introduction of the scheme having been made before removal of the business from Thames Ditton. In a Report made to the House of Commons by the Labour Department of the Board of Trade in 1895 on "Gain Sharing" (the Report was afterwards printed for public circulation), the system then in operation in the Willans Shops is specially described.

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